Industrial QUALITY CONTROL

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QUALITY
through
Scientific Methods

1946—TENTH ANNIVERSARY YEAR—1956

Journal of the
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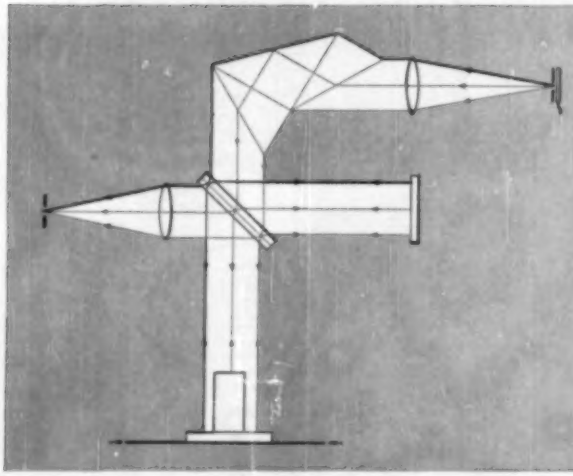

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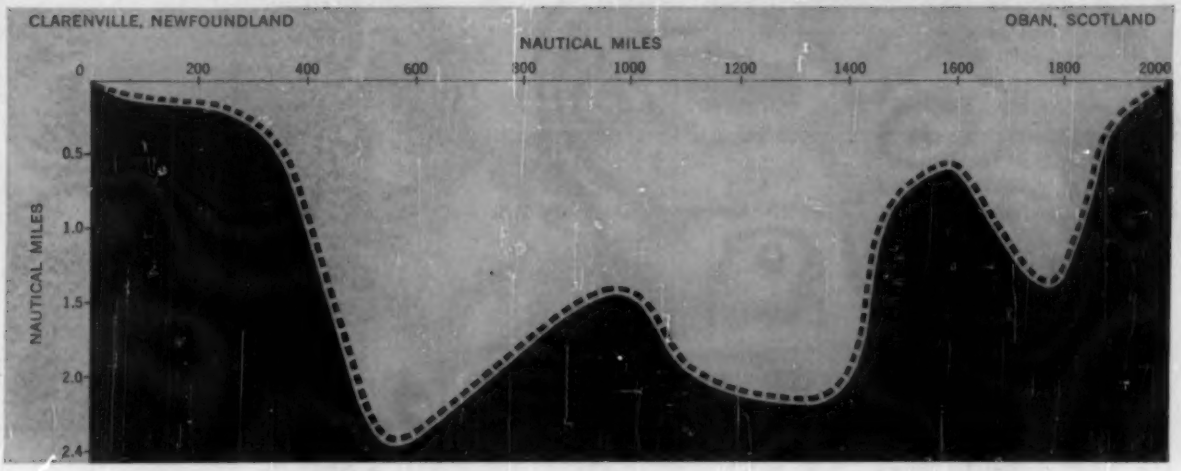

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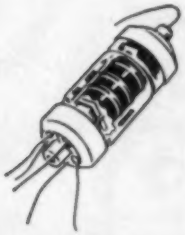

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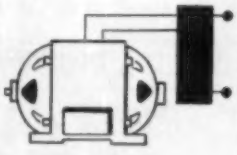

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From the President's Desk

Our New Administrative Secretary

Your Officers and Directors are pleased to announce the selection of Mr. William P. Youngclaus, Jr., for the new post of Administrative Secretary of our Society. After many months of searching for a suitable administrative officer to manage the affairs of the Society, the present officer group believes that the addition of Mr. Youngclaus to our staff represents a real step forward for our organization and fills a long-felt need for competent guidance and management of our operations.

Mr. Youngclaus, who will assume his new duties in Milwaukee on about November 15, is currently Administrative Secretary of the American Society of Lubrication Engineers. In this capacity, he has been responsible for operation of that Society's headquarters in Chicago, for management of its annual conventions, and for the business management and advertising program of the Society's journal, *Lubrication Engineering*. In addition he has been directly concerned with membership affairs and section development of that Society. Mr. Youngclaus brings to ASQC a wealth of experience in those areas of Society operation in which we are most needful of assistance at this time.

A graduate of Northwestern University in 1935 with a BS in Mechanical Engineering, Mr. Youngclaus' industrial experience consists essentially of sales engineering work with the Penzoil Company, Flexpansion Corporation and the Alemite Division of the Stewart Warner Corporation. Thus he has, by reason of both formal education and industrial experience, an engineering background. Combined with his management experience in Society work, this background will prove most valuable to ASQC.

Our new Administrative Secretary is a member of many professional organizations, including the American Society of Mechanical Engineers, American Society of Lubrication Engineers, American Petroleum Institute, American Institute of Management, National Association of Exhibit Managers, and the Council of Engineering Societies' Secretaries, and he is currently a Director of this latter organization.

Mr. Youngclaus resides with his wife and two children in Glenview, Illinois, where he has been interested in organized baseball for youngsters through participation in the work of the Little League, Pony League and Colt League. His new duties with ASQC will, of course, call for establishing his residence in Milwaukee vicinity.

At the time of the consolidation of our Society's offices earlier this year, provisions were made for suitable office quarters and facilities for an Administrative Secretary. Thus, Mr. Youngclaus will find in Milwaukee not only a staff of competent people carrying on the headquarters' office and publication work of the Society, but also a waiting office and a challenging work assignment.

Those of us who know Bill Youngclaus welcome him as one of us, and we are sure that as other members of our Society become acquainted with him they will find a warmth and friendliness that will make working with him a real pleasure.

Welcome to ASQC, Bill!

DALE L. LOBSINGER

Quality Control of Complex Assemblies

PAUL A. ROBERT* and MICHAEL C. BUGONIAN

International Business Machines Corp., Endicott, N. Y.

The use of formal techniques for controlling the quality of finished products is constantly increasing and constitutes one of the large fields of application for the statistical approach.

Consumer Quality

Up to the time that a product is completed, it is customary to think of quality in terms of conformance to established specifications rather than the "end use" or consumer idea of quality. In controlling the quality of a finished product, a new element is introduced.

The consumer's idea of quality may be quite different from the idea of quality expressed by the engineer. Customers are likely to think in terms of inconvenience caused by a defect, rather than the seriousness of the defect itself. For example, if a stapling machine in a paper container plant fails to function properly, the trouble may be very minor from a serviceman's point of view. He may require only a few minutes to make an adjustment which will restore the machine to proper working order. However, if the trouble causes the production line to be stopped with a resultant costly delay in the work schedule and inconvenience to the user, he considers the trouble as very serious rather than minor. This same thinking by the consumer is evident in the case of refrigerators, television sets, typewriters, automobiles, lawn mowers and other products where seemingly minor troubles result in inconvenience, disruption of work schedules or threats to personal safety.

According to Ephraim Freedman, director of the bureau of standards of R. H. Macy Company in New York City, some products have customer complaint rates which are as high as 25 percent of sales. In an address before the Rochester Section Clinic†, he painted a very sorry picture of the quality of goods being manufactured in some plants and stated that, in his opinion, this was due largely to the fact that manufacturers think too infrequently in terms of the consumer. It is important that manufacturers do not restrict themselves to compliance with specifications and shop ideas of good workmanship but that they be comprehensive and consider the reaction of the consumer.

Objectives of Quality Control

Let us consider the reasons for controlling and evaluating the quality of a product.

First, and foremost, is the prevention of shipping substandard products to the customer. Any effective control technique should set up a barrier against the continued shipment of more than a specified maximum percentage of defective articles. As will be shown later, some techniques for doing this are more effective and operate more promptly than others.

Second, since it is ordinarily uneconomical to conduct 100 percent inspection and rework operations to correct material which has been made defective during manufacture, the quality control technique points up those defects which, because of their nature and/or frequency of occurrence, warrant corrective action.

Third, for the proper overall management of an operation, it is important that the plant executive have quality performance figures fully as much as figures on cost and production. Production, cost, and quality are interrelated and, for proper administration of these functions, top management requires factual measures of each.

Finally, quality reports also serve to supervise the inspection function itself. Just as inspection reports reflect the quality produced by the operating personnel, quality reports also can be made to provide a means of evaluating the effectiveness of the inspection operation.

Types of Quality Control Plans

In general, there are three types of quality control plans for finished products.

First, and probably most common, is the final inspection plan. This type of plan requires that all or a sample of the product lot be examined or tested by inspection and that the product lot be accepted or rejected on the basis of their findings.

Second, a sample of the product is tested in a laboratory under aggravated or accelerated conditions to simulate long and arduous use. This performance test is usually continued until failure occurs, and its purpose is to disclose both design and manufacturing weaknesses. The tests often include simulated shipments to the customer and operation under environments of extreme heat, coldness, pressure, moisture, etc.

Third, a survey of field performance is conducted by measuring failures, complaints, service time, consumer reaction studies, returned equipment, etc.

In all types of quality evaluation, it is not possible to determine a firm and absolute measure of the intangible factor known as quality. As has been indicated, it has various meanings for different individuals. As a result, the most appropriate indicators or measures of the characteristic are usually selected.

However, because no single plan yields all the necessary information, a true quality control system cannot be maintained unless all three plans are employed and an analysis of their results made in order to evaluate properly any single characteristic.

Advantages and Disadvantages

Each of the plans mentioned has merit, and generally all three are employed. Let us consider the advantages and disadvantages of each of these plans.

The final inspection plan obviously gives the earliest indication that trouble exists. Since inspectors have been trained to check adjustments, good workmanship, etc., they are sensitive to conditions which may be latent sources of serious trouble. Thus, at this stage there exists an indirect means of controlling the long-term quality as well as the present performance.

*Mr. Robert is now with Gruen Industries, Inc., Cincinnati, Ohio.

†Mr. Freedman's article was published in the May 1955 issue of IQC.

The final inspection plan also makes it possible for a small number of people to inspect a large number of characteristics and units and thus develop in some respects a more reliable measure of quality.

On the other hand, inspectors do not necessarily view a product in the same light as the customer does. They may detect defects which a customer would be unlikely to see, but they also may discount as trivial some defects which the customer would regard as important. By careful planning and training, a formal inspection procedure can be employed which will help to overcome this deficiency.

Final inspection also may fail to discover defects of characteristics which are hidden or inaccessible and which become apparent only after the product has been in service for some time.

In performance testing, the quality evaluation is more objective and scientific. The item being tested is under observation for a long period and latent defects have an opportunity to appear. The evaluation is usually made by highly skilled and trained personnel with a point of view which parallels that of the consumer. In this test, each failure can be critically analyzed and the exact cause of each defect can be determined.

"In many cases, this testing may be integrated with process control and earlier designs. Depending upon the product, the qualification of the prototype prior to production may prove to be the best possible and least expensive protection. Whenever process inspection is conducted prior to final inspection, much information can be gained about the characteristic and its ability to remain stable. The data gathered during process inspection may prove of great value in later evaluations of customers' complaints."*

However, not only is this type of test expensive, but the very small sample selected may not be truly representative of production in general. The test also requires so much time that results are not available until months after the test has been started.

It might be said, "that the proof of the pudding is in the eating," and therefore, the field test of a product is a measure of its true quality. It is most likely to reflect the consumer's point of view regarding quality. If the field test is properly designed, it can reflect a cross section of the applications for which the product is used.

Unfortunately, the field test also has its disadvantages. Sometimes products are misused by the customer, thereby requiring a disproportionate share of service time for the repair of defects which are not the responsibility of the manufacturing organization.

Also, although many defects become apparent at the time of installation, many others do not, and due to the fact that the conditions of use do not tax the equipment in some applications as much as in others, there may be a long lapse of time before the defect appears.

Ordinarily, this type of test must be considered a long-range proposition, and the administration of such a program can involve substantial problems. However, if the field organization is closely integrated with the parent organization, this program can provide an effective measure of "true" quality.

Final Inspection Plans

The first step in the development of a final inspection plan requires the preparation of a "laundry" list of all possible defects. This list ordinarily is compiled by reference to engineering specifications, performance data, inspection records, field complaints, and the experience of inspectors, foremen and engineers.

It is important that the end use of the product always be considered and that the inspection plan be drawn up so that it encompasses the requirements of the consumer. Too frequently, personnel in the manufacturing area think in terms of good workmanship and engineering specifications, without considering the requirements of the user.

The second step is the classification of defects by degree of seriousness. Four or five categories are used generally, and most companies employing this technique adopt the terms; Critical, Major, Minor B, and Incidental. However, some companies may use a variation of these categories to serve their particular needs.

The critical category is usually, but not necessarily, confined to products which are used by the military. A critical defect, as it applies to the military, is one which could result in unsafe or hazardous conditions for the individuals using or maintaining the product or which could forestall the performance of a product's tactical function.

The major category is usually used for defects, other than critical, which could affect adversely the operation of the product for its intended use.

In our application, we have been forced to depart from the customary definition of a major defect. Due to the fact that most of our machines are leased and customer engineers service the equipment without charge to the customer, the seriousness of a defect must be considered in terms of the loss of use by the customer and the cost of service to the company. For this reason, the product, its use, and the conditions of sale, are factors which have necessitated that the following defects be classified as major:

1. Defects which, for their proper correction, require fixtures, tools or gages not carried in the customer engineer's tool kit.
2. Defects which require the removal and disassembly of a major unit of the machine.
3. Defects which cannot be readily detected or identified, such as electrical connections, and therefore are responsible for excessive service time.

This point is made because each application of this technique should be considered separately, and the quality engineer should not be bound by textbook definitions unless he feels that they are applicable in his particular situation.

The proper classification of defects is determined best by a small gathering of personnel who represent assembly, engineering, field, and quality control management. The thinking of this group can evaluate correctly the seriousness of different defects. Moreover, if these various departments participate in the development of the plan, the first step toward obtaining their cooperation for carrying out the plan has been accomplished.

Demerit Values

After the classification of defects has been established, it is customary to assign demerit values to these defects for the purpose of determining a single figure or index which can be interpreted as a measure of the quality of a total unit. Again, it is important that the assignment of demerit values reflects the thinking of the group.

The demerit value is a factor which is assigned to a defect to give it emphasis in relation to other defects so that the sum or average of a number of defects has significance as a measure of quality.

*Communication from Harry G. Romig.

The development of the relative positions of critical, major and minor defects is not an easy task. There are a number of standards which can be applied, but these will differ for various types of products. For example, our situation with accounting machines demands that the service time required to analyze and correct defects be the primary consideration. Undoubtedly, the factor of safety is the matter of greatest concern in an aircraft plant. The manufacturer of electrical appliances will probably regard appearance, salability and trouble-free operation as the most important factors.

It is rather interesting to note that in the nine "demerit weighting plans" which appear in Fig. 1, a ratio of between 2 and 3 to 1 exists between the major and minor defects in eight of the plans. In five of the plans, the ratio of minor to minor B defects is between 4 and 5 to 1.

Use of Double Code

The listing of all the possible defects in a product, which is particularly complex, can result in a very long list, especially if an attempt is made to identify the trouble. For example, a spring may be weak, worn, broken, incorrect, missing, etc., and a gear may be loose, binding, dry, damaged, etc.

Usually, it is desirable to identify a defect with sufficient exactness so that the cause can be deduced and corrective action taken. The use of a double code minimizes the number of items which appear on the defect list, yet it defines the defect with the required preciseness. One section of the list contains code numbers which represent characteristics, and another section contains the code numbers identifying troubles which may be associated with the characteristics. A combination of the two codes therefore indicates a specific characteristic or item in the product and the particular trouble which caused the item to be defective. An example of the trouble code list is shown in Fig. 2.

There are a number of points that generally come up in defect evaluation. One is the effect of the "extent of deviation from specification." If an adjustment is only slightly beyond the specification, its effect on performance may be minor, but if it deviates substantially from the specification, its effect may be more serious. It has been our practice to assign just one classification to a defect without any attempt at making this refinement. It could be done in certain important mechanisms, and undoubtedly it will be given consideration as refinements in our plan are made.

Another point to be considered is the scoring of the number of defects. For example, if an operator fails to lubricate a mechanism, should each dry bearing be scored as a defect or should the lack of proper lubrication be scored as one defect? The same problem arises when scoring defects which are repeated because of a single oversight or a wrong starting adjustment. The manner of scoring these items makes a big difference because the overall quality index may become distorted if individual defects resulting from a single cause are counted. The importance lies in determining how the defect is created and what its effect on product quality will be.

Another consideration is the establishment of a performance standard. Some plans call for a "base period" standard. The period, which is to be used as a guide, is one during which quality was good, costs were low, and the complaints or service hours related to the products produced during the period were few. In short, the period is one in which an economical level of quality has been attained. Other plans establish an "ideal" based on the number of possible defects in a product. For most products, this would be rather difficult to obtain. An approach might be made on the basis of recording the total number of various defects over a long period of time and determining the typical probability of occurrence for each defect. The total probability would then be the sum of the individual probabilities.

If a standard is required, a good beginning can be made by tabulating the defects for a period, analyzing the distribution and setting a standard on the basis of judgment.

TROUBLE CODES	
0 1	SHORTED/GROUNDED
0 2	STICKING/BINDING
0 3	STRIPPED
0 4	TIMING
0 5	WEAK/OPEN
0 6	WORN
0 7	SURFACE FINISH
0 8	DAMAGED
0 9	INCORRECT/MISSING
1 0	ADJUSTMENT
2 0	ALIGNMENT
3 0	BENT/WARPED
4 0	BROKEN
5 0	BLOWN/BURNED
6 0	DIRTY/CORRODED
7 0	DRY
8 0	LEAKING
9 0	LOOSE

Figure 2

COMPARISON OF DEFECT CLASSIFICATION AND DEMERIT WEIGHTING

CLASS LETTER OR NUMBER	CLASS NAME	ELECTRONIC MFG. DIV. HUGHES AIRCRAFT CO.	WRIGHT AERONAUTICAL DIV. WOODRIDGE, N.J.	JURAN, QUALITY CONTROL HANDBOOK	BELL TELEPHONE SYSTEM	HQ. 15TH A.F. MARCH A.F. BASE	H.A.C.O.C. POLICY MANUAL	FEDERAL TELEPHONE SYSTEM	G.E. AND A.F.O.C. PLAN LYNN, MASS.	IBM CORP.
A I	CRITICAL	–	–	–	–	500	–	–	–	–
B II	MAJOR	10	10	100	100	100	10	50	50	15
C III	MINOR	5	5	75	50	50	5	20	25	5
D IV	MINOR B	1	1	25	10	5	1	5	10	–
E V	INCIDENTAL		0.1	5	1	1	0.1	1	5	1

Figure 1

Establishing AQL

If the product is to be inspected on a sampling basis, an AQL (Acceptable Quality Level) must be established by an analysis of the consumer's requirements. After this value has been determined, reference may be made to standard sampling tables to select a sampling plan for the specific AQL. The AQL is a target value and lots which are of AQL quality will be accepted by the plan about 95 percent of the time. Due to the errors of sampling, lots which have a percent defective worse than the AQL value will be accepted part of the time and the process average can be somewhat greater than the AQL. Therefore, to control the quality to the desired level the producer maintains a record of the percent defective of the lots as a result of his inspection. The process average is

compared with the limiting values contained in MIL-STD-105A. If the percent defective consistently falls between the upper and lower limits for the specified AQL, it is an indication that the process average is being maintained. If the percent defective lies outside the limits, inspection is increased by means of a tightened sampling plan. If conditions indicate that the estimated process average is less than the lower limit, inspection may be decreased by use of a reduced sampling plan. Thus, inspection is performed on a reduced, normal, or tightened basis as the quality of incoming material indicates the need.

Outgoing quality may also be controlled by using the concept of AOQL (Average Outgoing Quality Limit). In this procedure, appropriate sample sizes and acceptance numbers are selected from AOQL sampling tables, such as those compiled by Dodge and Romig, that will in themselves guarantee the quality level. The producer selects an AOQL value which is a limit of the long-run quality of the product which will pass inspection provided all lots which are rejected by the sampling plan are inspected 100 percent and accepted after removal of all defective units.

For the most effective use of the tables, the inspection department should have some knowledge of the average fraction defective or "process average" of the incoming units. Where a new unit is being inspected for the first time, the approximate quality may have to be determined from a preliminary sample. After the program has been in operation for a while, the inspection department will be able to establish the most efficient sampling since the process average will be known. If the average quality of the product being inspected is substantially poorer than the AOQL of the sampling plan, the number of lots which must be rejected and inspected 100 percent will be so large that the cost of the sampling plan will be almost as great as the cost of 100 percent inspection.

In many cases, the use of a continuous sampling plan with a desired AOQL would be advantageous if the product is made by a conveyor or continuous process. The costs involved in this plan are less than the cost of 100 percent inspection so long as the percentage of lots which are rejected and inspected 100 percent is not too great.

In either case, quality improvement is obtained by exerting pressure in two ways. If the units are made in the manufacture's plant, the responsible production department is charged with the costs entailed in 100 percent inspection of the rejected lots. If the units have been made by an outside producer, the rejected lot is returned to him for correction.

To cite a case in which quality improvement was obtained by returning rejected lots to the producer, we were purchasing a rather complex unit from a subcontractor and 100 percent inspection had been necessary to maintain a proper quality level. Since it was not possible to conduct inspection on a sampling basis because the producer had not been able to comply with the standard, we bore the burden of 100 percent inspection, and the subcontractor had little reason to improve the quality. The problem was solved by setting up two quality levels. We decided that if a sample met the first quality level, we would conduct 100 percent inspection to reach the second quality level. If the second level was not reached, the material was to be returned to the subcontractor. As a result, the quality finally improved so much that the second quality level was reached, and the units are now being inspected on a sample basis. The "double standard" served its purpose of setting an immediately attainable quality level, and the returned lots exerted pressure on the subcontractor and forced him to improve his quality.

Control Limits

It is possible to compute control limits for demerits per unit charts in the same manner as they are computed for "p" charts. The formula is as follows:

$$\sigma_d = \sqrt{\frac{C_s}{n}}$$

where

$C_s = w_1^2 p_1 + w_2^2 p_2 + w_3^2 p_3$

and w_1 = weighting factor for majors

w_2 = weighting factor for minors

w_3 = weighting factor for incidentals

p_1 = fraction defective major

$$= \frac{\text{(No. of major defects)}}{\text{(No. of units inspected)}}$$

p_2 = fraction defective minor

$$= \frac{\text{(No. of minor defects)}}{\text{(No. of units inspected)}}$$

p_3 = fraction defective incidental

$$= \frac{\text{(No. of incidental defects)}}{\text{(No. of units inspected)}}$$

n = number in sample

A hypothetical case will be used to show how the standard deviation is computed.

The inspection of a certain product during a certain period resulted in defects as follows:

250 major defects
700 minor defects
120 incidental defects

The weighting values are:

$w_1 = 15$ demerits
$w_2 = 5$ demerits
$w_3 = 1$ demerit

Therefore the total number of demerits for the product is:

$$\begin{aligned} 250 \times 15 &= 3750 \\ 700 \times 5 &= 3500 \\ 120 \times 1 &= 120 \\ &\overline{\quad 7370} \end{aligned}$$

The total number of units inspected during the period was 100. Therefore, the average demerits per unit for the period is:

$$7370 \div 100 = 737$$

This is a measure of the product quality produced.

$$C_s = (15)^2 250 + (5)^2 700 + (1)^2 120/100 = 738.7$$

$$\sigma_d = \sqrt{\frac{738.7}{100}} = 2.72$$

The control limits define the extent to which the average may be expected to shift if chance causes alone are present.

A common practice uses $\pm 2\sigma$ from the average as the control limits in manufacturing, with a probability of about five percent that no assignable cause exists for a point beyond these limits. The use of $\pm 2\sigma$ limits indicates a need for investigation of a significant change in the average much sooner than the more inclusive $\pm 3\sigma$ limits.

For management reports, the $\pm 3\sigma$ limits are customarily used because points beyond these limits almost always represent the presence of assignable rather than

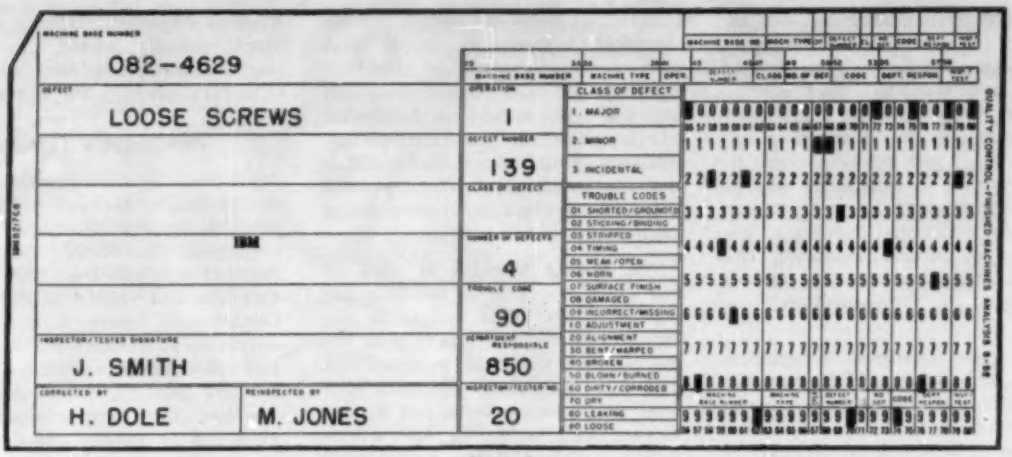

Figure 3

chance causes of variation. With ± 3σ limits, the probability of a point beyond the control limits due to chance alone is only about 0.25 percent.

To illustrate how control limits are used, suppose the standard average demerits per unit (based upon a long period of production) is 66.4. The average demerits per unit figure for the past period is 73.7. Has there been a significant change in the average or can this increase be due to chance causes alone? Using the σ of 2.72 which was derived previously, the ± 2σ limits would be 61.0 and 71.8. This indicates that an assignable cause may be responsible for the out of control point, and an investigation should be made to determine the cause.

Analysis of Quality Data

Second to controlling quality, probably the most important function served by a formal technique is that of pinpointing the need for corrective action.

Recording the quality data on cards which are subsequently processed by means of electric accounting machines equipment not only simplifies the clerical task of computing the average demerits per unit, but it also makes possible detailed analyses which indicate where corrective measures are needed most urgently. A typical card of this type is shown in Fig. 3.

The cards may be sorted by defect number and a report prepared which shows the frequency of occurrence for each defect and the particular troubles causing the defects. The items requiring attention can be determined readily by scanning the report. A portion of a report by defect number is shown in Fig. 4.

The same cards can be regrouped to prepare a report by department responsible. Copies of this report, which itemize each defect, the frequency of occurrence, and its effect upon the quality of the products, are sent to the foremen of the departments responsible for the defects. This assignment of responsibility for particular defects constitutes the first step toward obtaining corrective action.

IBM

FINISHED MACHINES QUALITY ANALYSIS

1. BY DEFECT NO. [X]
2. SUMMARY BY UNIT AND DEFECT NO. [ ]
3. BY DEPARTMENT RESPONSIBLE [ ]

WEEKLY ( ) MONTHLY (X) PERIOD ENDING DEC. 31 1953

MACHINE TYPE	OPER. NO. OR DEPT. RES.	DEFECT NO.	DEFECT NAME	CLASS OF DEFECT	TROUBLE CODE	NUMBER OF DEFECTS
999	2	100	MOTOR & PUMP UNIT			
	2	101	BRUSHES	2	1	1
	2	101	BRUSHES	2	6	114
	2	101	BRUSHES	2	8	69
	2	101	BRUSHES	2	9	10
	2	101	BRUSHES	2	10	29
						223
	2	102	CAPACITOR	2	1	4
	2	102	CAPACITOR	2	5	11
	2	102	CAPACITOR	2	8	2
	2	102	CAPACITOR	2	10	3
	2	102	CAPACITOR	2	40	1
						21
	2	103	MAGNET ARMATURE	1	4	4
	2	103	MAGNET ARMATURE	1	10	4
						8
	2	105	CONTACT UNIT	2	4	1
	2	105	CONTACT UNIT	2	10	3
						4
	2	107	MAGNET LATCH	2	90	2
						2
	2	108	CONTACT UNIT	3	90	5
						5
	2	109	START CONTACT	1	10	1
	2	109	START CONTACT	1	90	1
						2
	2	114	WIRING	1	9	3
						3
	2	115	IMPELLOR BLADE	2	10	30
						30
	2	116	DEFLECTOR	2	2	2
						2
	2	117	GUIDE	2	7	48
	2	117	GUIDE	2	90	23
						71
	2	118	MP BASE UNIT	2	2	1
	2	118	MP BASE UNIT	2	4	8
	2	118	MP BASE UNIT	2	7	1
	2	118	MP BASE UNIT	2	10	5
	2	118	MP BASE UNIT	2	90	4
						19
			UNIT NAME AND FIGURES ARE FICTITIOUS			*390

CLASS I DEFECTS	CLASS II DEFECTS	CLASS III DEFECTS	NUMBER OF MACHINES	NUMBER OF DEFECTS
2594	3817	1718	3390	8129

Figure 4

A report by inspector can also be prepared by sorting the same cards by inspector number. This type of report can be made to show the comparative performance of a group of inspectors who are inspecting the same type of product. A review of the difference in inspectors can be very enlightening. It may indicate a need for additional training or instruction for certain inspectors. The report serves also as a fine tool of supervision for the inspection foreman.

If a more extensive analysis is needed, other types of reports can be prepared from the same cards by controlling on other factors. Electric accounting machine equipment is capable of handling a tremendous volume of quality data so rapidly that many quality analyses, which would be prohibitive if manual methods were employed, are practical on a monthly, weekly and even daily basis.

Automation and Quality Control

In the near future, it is likely that elaborate testing machines will be widely used on manufactured products for the purpose of accumulating, summarizing, and analyzing defects of a mechanical, electrical, and electronic nature at a greater speed and lesser cost than present manual methods entail. A machine of this type has been designed by our engineers and is presently being used to test the electrical circuits of machines on our production line. The testing machine makes use of a system of punched card programming by which precomputed data are punched into the cards which automatically and rapidly conduct the tests. This feature makes it possible for the operator to test a variety of products without being required to remember the technical details of each product. The complete test of the product is made without stoppage of the testing machine when defects are found because the results of the test are recorded on a printed form which the operator consults in order to pick out and correct the existing defects. Because the results are recorded, the testing machine may be checking the next unit of product on the production line while the operator is making corrections on the previous unit tested. The identification of each test circuit and its extent of deviation from the mean specification appear on the printed form. An accumulation of the detailed data produced by these tests can provide a statistical basis for comparing the electrical components under test with the performance of the machines in the field. Engineering can use this information to determine whether existing specifications are satisfactory and as a basis for altering specifications if the test and performance data indicate changes are necessary.

The testing machine is used on our machines prior to the final acceptance test. This test is so designed that the performance of the machine in the field is simulated. The testing machine does not conduct performance tests, but by detecting defects which are subsequently corrected by a repairman prior to the performance test, it shortens and simplifies the performance test considerably. Frequently, the testing machine has detected marginal conditions which would have required field servicing eventually and which probably would not have been detected by the final acceptance tests.

Since it is usually unnecessary for the equipment undergoing the test to be in a state of operation, the testing machine can be used to check partial assemblies or circuit sections as well as machines which are completely assembled and wired. Any components or sub-assemblies which contain tube sockets, terminal strips, connectors or printed circuits could be checked on the assembly line by the testing machine and repairs made immediately afterward with a large savings in testing and repair time resulting.

It is possible in the near future that a later model of the testing machine will also punch the test results on cards in addition to recording them on a printed form. With the use of electric accounting machine equipment, test results from many machines over a long period of time could be summarized and statistically analyzed very rapidly, whereas the same job performed by manual methods would prove very tedious and costly. The information obtained from an analysis of many test results by machine method would provide engineering with a surer basis for taking action on existing specifications.

The area of electrical resistance testing constitutes only one area of use. The existence on the market of a wide variety of items which can convert physical and chemical quantities into electrical units for input to the measuring circuit, makes possible the measurement of such quantities as vibration, pressure, temperature, velocity, strain, etc. by the use of testing machines similar to that developed by our engineers.

Performance Testing

In order to obtain a relative measure of quality through performance tests, a demerit technique can be employed. Periodically, we select a finished machine from the production line and send it to the Testing Department where it is put into operation on a round-the-clock basis and subjected to a critical examination by test engineers. As defects develop, they are evaluated and classified as major, minor or incidental and assigned a demerit value. Although the test engineers do not have a formal classification of defects, the definition of each class is so objective that each defect can be classified definitely at the time of detection.

It is possible to obtain the equivalent of normal life in a few months by an accelerated test in which the unit is operated continuously under aggravated environmental conditions.

The test can be terminated at any time, but the most logical period for the performance test is for the "expected" life of the product. There may be some justification for using the "guarantee" period, but ordinarily this time is so short that the relative quality of units has little opportunity to be measured.

Since it is not possible to duplicate perfectly the conditions of actual use, the differences must be considered in the evaluation of results.

When the test is ended, the vital units are disassembled and examined for evidence of abnormal wear and impending failure. Each condition observed is classified and assigned a demerit value. The test engineer prepares a narrative summary supporting the demerit rating which assigns responsibility to Engineering or Manufacturing so that corrective action can be taken by the group which has primary responsibility for the condition.

In our plant, the cost of the unit and the length of the test necessarily requires that the number of machines to be tested be carefully weighed. Without doubt, companies manufacturing less complex and less expensive products in larger quantities would find it practical to test a large number of units.

The scoring system used by our Testing Department, which is essen-

tially the same as that used in Final Inspection, is given below:

major	—	13 to 17 demerits
minor	—	4 to 7 demerits
incidental	—	1 to 2 demerits

The test engineer is allowed a range in scoring a defect because it is felt that his training, experience, and the thoroughness of his examination make it possible to weigh each defect with greater discrimination.

The Testing Department has defined major, minor and incidental as follows:

Major

1. Defects which, for their correction, require fixtures, tools or gages not carried in the domestic tool kit.
2. Defects which require removal or disassembly of a unit for their correction. Units, such as counters, which are designed for easy removal are not included.
3. Poor electrical connections or contacts, which cannot be identified by visual means alone.
4. Safety hazards which require exercise of unusual precaution.
5. Troubles which require replacement of parts not ordinarily carried by the Customer Engineer.
6. Conditions which, if neglected, could result in defects as outlined in 1., 2., 4., or 5. of the major classification within a 90 day period.

Minor

1. Defects which require corrective action and can be accomplished readily by means of customer engineering tools without disassembly or removal of a major unit.
2. Potential safety hazards which could result in slight injuries to the operator.
3. Defects which, if neglected, could result in defects as outlined in 1. of the minor classification within a 90 day period.

Incidental

1. Defects which do not affect the operation of the machine but which, if neglected, could produce a machine malfunction.
2. Small imperfections in machine appearance which are not serious enough to cause customer dissatisfaction.

In the course of time, we hope to correlate the test results, final inspection data, and field performance information. At the present time, a relationship is not apparent, but a detailed analysis of the defects reported and their impact upon the final score or quality index over a period of time should explain the reasons for the differences among them.

Field Performance

The measurement of quality in terms of field performance involves the selection of an appropriate quality index which is representative of the general quality of the product. The number of service calls during the guarantee period, the dollar value of replacement parts, the number of complaints and the number of returned units are only a few of the many indexes which have been used to indicate the quality of manufactured products. There is probably no single index which might be used universally. No doubt, the type of product will govern the particular quality index which is most appropriate in each case.

Dr. Juran points out in his Handbook that the number of complaints may depend too much upon the condition of the market, the customer's inventory, the customer's temperament and other factors unrelated to the quality of the product.

Since many of our products are leased and service is included in the rental, we have selected the average service hours per unit per month as the quality index. The selection of this index was based upon the assumption that a direct relationship exists between the amount of time required to repair equipment and the number and gravity of defects, i.e., the more numerous and serious the defects, the more service time is needed to discover and remove them. Therefore, it is apparent that the amount of service time expended on a product can be used as a measure for indicating the degree of quality being produced at the factory.

The selection of this quality index was not made without overcoming some irritating problems. For example, the ability and experience of the customer engineer is obviously related to the amount of service required to discover and eliminate defects. Ordinarily, more experienced personnel require less time for repair. More recent models or new products usually require more service time than older models or products which are more familiar to the customer engineer. Customer engineers in provincial territories are responsible for a greater variety of products than customer engineers in metropolitan areas who specialize on fewer products. Therefore, they are likely to need more time to diagnose and repair troubles.

In order to balance and randomize the many variables which were likely to become involved in this field performance evaluation, an expert on polling and market surveys was asked to conduct a study of the problem. The result of his study, which was based on a consideration of such factors as geographic area, type of application, type of service required by the customer and the nature of the territories (urban versus provincial) was the selection of a sample of offices from which service time data were to be obtained.

Selection of Period

The selection of a proper period for the accumulation of data also posed a problem. Varied opinions were given by managers and quality engineers regarding an appropriate period. Some favored obtaining data at the time the machine is installed and tested, others felt that the data resulting from the first 90 days of operation should be used, and a few considered the data compiled in the first year as most appropriate.

The proper period depends in great measure upon the type of product, the type of inspection, and the test conducted on the product at the time of installation. If the product is thoroughly examined and/or defects are likely to appear upon installation, it is conceivable that an enumeration of these defects would constitute a good index of product quality.

However, in the case of a complex unit with many parts, it is likely that troubles which could not be detected at the time of installation will develop at a later date. A logical argument can be made that latent troubles can remain hidden for a period longer than 90 days. For example, defective heat treating operations may result in soft parts which may not show up for six months or even a year.

The pros and cons of various proposals were discussed, and agreement was finally reached that, for our purposes, any field troubles

which appeared in the first 90 days of operation would be considered the logical responsibility of the manufacturing organization.

The longer the period is extended, the more likely it becomes that the quality of design rather than the quality of manufacture is responsible for the defect. A part or unit which is structurally inadequate to withstand the rigors of prolonged service will fail because of unsound design no matter how well the manufacturing organization has done its job.

The data accumulated during the 90 day performance of machines which are shipped to sample offices is put into a report known as the 90 Day Trouble Analysis. A portion of this report is shown in Fig. 5. This summary sheet shows, among other items, the quantity of machines surveyed, a distribution of the calls and service hours per unit for the 90 day period, and a distribution of the average calls and service hours per machine per month for each unit. The average figures are obtained in the following manner. The totals for the period are divided by the quantity of machines to derive an average figure for the 90 day period. This average is then divided by three, and the result is the average figure per month. For example, the average calls figure for the Contact Unit, which is 0.9, is the result of dividing the total calls figure 255 by 94 and further dividing the result by three. In the case of some units, the total number of calls and service hours during the 90 day period are relatively very small, and the resulting average per month figures are so insignificant that they do not appear on the report. This omission sometimes results in a slight discrepancy between the listed total of the averages and the actual sum of the listed averages. However, this very minor variation does not detract from the value of the report.

Detailed listings by unit, part number and trouble code also comprise part of the report. A report of this type enables Quality Control to perform a very complete and effective analysis since it points out the units which require the greatest amount of service time, the parts within the units which are responsible in the greatest measure for the defectiveness of the unit and the specific troubles associated with the defective parts. Because the report spells out the causes and areas of defectiveness so precisely, Quality Control is able to make considerable progress in improving quality by applying corrective action wherever the report indicates it is needed most urgently.

Another report known as an Age Study by Year of Manufacture is prepared on the same form as that used for the 90 Day Trouble Analysis. This is a summary of service experience on all machines which are 1, 2, 3, 4 and 5 years old. An accumulation of data beyond the 90 day period is necessary for the preparation of this report. The Age Study by Year of Manufacture is used mostly by Engineering for evaluating the soundness of design, the "expected" life, the effect of improvements in design, and other items of interest.

For comparative purposes, the average service hour per unit per month figure on the 90 Day Trouble Analysis is plotted on a chart which is then distributed, together with charts showing the results of product test and final inspection, to management personnel most immediately concerned. A sample of this chart is shown in Fig. 6.

The function of the Quality Control Division involves gathering all of these data, analyzing it so that areas of responsibility are fairly well defined, and publishing the quality data for the use of assembly and manufacturing managers.

IBM 90-DAY **TROUBLE ANALYSIS** **EAM**

QUARTER 4TH MONTH_____ WEEK ENDING 53 CUSTOMER ENGINEERING DEPARTMENT

MACHINE TYPE	UNIT CODE	PART CODE	UNIT OR PART NAME	TROUBLE CODE	MACHINES ANALYZED QUANTITY BY TYPE	TOTAL FOR PERIOD CALLS	TOTAL FOR PERIOD HOURS	ALL MACHINES ANNUAL HOURS*	AVER. PER MACHINE PER MONTH CALLS	AVER. PER MACHINE PER MONTH HOURS	% OF UNIT OR PART CAUSED TO TYPE CODE	RANK WITHIN TYPE UNIT	RANK WITHIN TYPE PART
999	80		CONTACT UNIT		94	255	1015.1	4060	.9	3.6	23.8	1	
999	06		RELAY UNIT		94	209	611.4	2446	.7	2.2	14.3	2	
999	10		FEED UNIT		94	171	348.3	1393	.6	1.2	8.2	3	
999	00		BASE UNIT		94	131	323.2	1293	.5	1.2	7.6	4	
999	04		PUMP UNIT		94	68	280.6	1122	.2	1.0	6.6	5	
999	50		SWITCH CONTROL UNIT		94	92	240.7	963	.3	.9	5.6	6	
999	60		GEN RECT UNIT POWER SUPPLY		94	44	210.3	841	.2	.7	4.9	7	
999	09		MOTOR AND DRIVE UNIT		94	45	133.5	534	.2	.5	3.1	8	
999	48		MAGNET UNIT		94	10	99.4	398		.4	2.3	9	
999	02		MOTOR CLUTCH UNIT		94	16	96.9	388	.1	.3	2.3	10	
999	05		TUBE CONTROL UNIT		94	25	86.1	344	.1	.3	2.0	11	
999	40		IMPELLOR UNIT		94	29	50.7	203	.1	.2	1.2	12	
999	30		AUTO VALVE UNIT		94	40	49.5	198	.1	.2	1.2	13	
999	12		CLUTCH UNIT		94	11	21.9	88		.1	.5	14	
999	03		EXHAUST UNIT		94	10	7.3	29			.2	15	
999	42		CAM UNIT		94	1	4.5	18			.1	16	
999			NO UNIT MENTIONED		94	133	367.3	1469	.5	1.3	8.6		
999			NO TROUBLE FOUND		94	35	206.6	826	.1	.7	4.8		
999			CUSTOMER ERROR		94	52	89.4	358	.2	.3	2.1		
999			CUSTOMER POWER SUPPLY		94	5	17.9	72		.1	.4		
999			UNASSIGNABLE UNIT NTF		94	2	2.5	10			.1		
999			CUSTOMER ATTACHMENTS		94	1	10.2	41			.2		
			TYPE 999 MACHINE		94	1385	4273.3	17093	4.9	15.2			
999			ASSIST TIME		94		548.2	2193		2.0	12.9		
			PERIOD SAMPLED 13 WEEKS										
			UNIT NAMES AND FIGURES ARE FICTITIOUS										

EAM TROUBLE CODES

01-Adjustment 10-Burned 31-Loose 46-Stripped 98-No Trouble Found
04-Alignment 19-Cord Jam 49-Oil Pumbed Card- 49-Timing 99-Incomplete (Applies to part coupled groups only)
07-Bent-Warped 22-Dirty-Corroded 37-Open 52-Weak
10-Blown 25-Dry 40-Shorted 55-Worn
13-Broken 28-Lubing 62-Sticking-Binding 97-Other

Figure 5

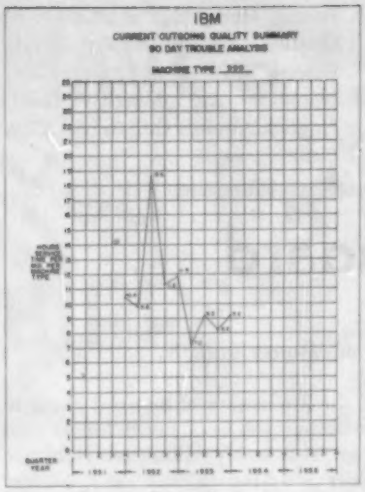

Figure 6

In our company, quality has always been the responsibility of the operating organization. Therefore, corrective actior is initiated by the responsible manager. The quality control organization assists by making studies, evaluating quality reports and inspecting the product to make certain that required quality is being maintained.

Analysis of Quality Reports

Since quality reports are measurements of an intangible, it is very important that managers or foremen be trained to use them properly.

It is a human failing for a manager or foreman to be critical of reports which indicate that he is responsible for certain defects. Instead of concentrating upon items which he is in a position to correct, he is too prone to look for defects which he feels should have been charged to somebody else. The effectiveness of the report can be seriously impaired if emphasis is allowed to center upon "who" is responsible rather than upon "what" is responsible.

Whenever attention is focused upon some particular condition because of its seriousness or frequency of occurrence, it is important to have sufficient detail so that the defect is clear and the person responsible for the defect understands what must be corrected. In the case of final inspection and field performance report analyses, the actual call report cards, which contain detailed accounts of defects, and which are used to prepare reports, can be obtained and reviewed. In this manner, complete information can be made available in the investigation of any particular trouble. The narrative account which the customer engineer makes on his call report card can be very helpful to the individual who is charged with the task of finding solutions which will decrease the recurrence of particular troubles.

Reports must be timely if they are to be effective. Operating management personnel are not completely satisfied unless they are presented with a quality picture the day after the product has been made. It seems that the older a report becomes, the less attention it receives, and a report on products which were shipped three or four months previous seems of value only for studying trends.

The total number of units produced of various products factor is sometimes an unsatisfactory index. An unusually low percent defective of a product which is produced in large quantities tends to outweigh or cancel out a high percent defective of products on which the production quantity is relatively small. The result may be a seemingly satisfactory quality index which obscures the existence of a poor quality situation which needs correction.

The complexity factor based on the estimated number of possible defects is suitable for many situations, but when large and highly complex products are involved, the determination and enumeration of all possible defects on the products becomes a tedious, costly and sometimes prohibitive task.

Again, the "expected" or "standard" demerits per unit for each component factor has met with the greatest favor and has been used with large success because it is the easiest to use.

In our company, we have not developed any overall indexes of quality because the general feeling exists that confidence in the effectiveness of individual measures must be built up prior to any attempt to combine them.

The preliminary period during which these measures are used to evaluate quality can be well spent in reviewing the results and making improvements in the system. As confidence in our system is developed, it is possible that we shall undertake the task of formulating an overall index of quality.

Conclusion

It has been truly stated that "to control, you must be able to measure." These measures represent the most effective controls developed up to the present time. In 1928, Mr. Harold Dodge, in an article published by the Bell Telephone Laboratories entitled, "A Method of Rating the Manufactured Product," outlined the principle features of the demerit rating system. Because this technique is fundamentally sound, its application has become increasingly extensive and, today, hundreds of plants are employing it to measure the quality of numerous types of manufactured products.

Although considerable progress has been made in the application of control techniques, there is much additional information to be learned. The purpose of this article has been to indicate and review some of the practical problems which present themselves when these techniques are applied and to stimulate thinking and discussion which may result in solutions to alleviate these problems.

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1. Dodge, H. F., "A Method of Rating Manufactured Product," Bell Telephone Laboratories, Inc., May, 1928

(Continued on page 14)

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GEORGE R. FOSTER,
Managing Editor.

Sworn to and subscribed before me this 12th day of September, 1956.

ROSEMARY HARDING,
Notary Public.

(Seal)
(My commission expires April 28, 1957.)

(Continued from page 13)

2. Grant, Eugene L., *Statistical Quality Control*, McGraw-Hill Book Co., Inc., New York and London, 1946
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Five Bases of a Standard

WALTER A. SHEWHART

Formerly Member of Technical Staff of Bell Telephone Laboratories, Murray Hill, N. J.

Editorial Note: The following short paper by Dr. Shewhart was presented at the Tenth Annual Convention of the American Society for Quality Control in Montreal in June 1956, in a session sponsored by the Standards Committee of the Society.

At Mr. Dodge's suggestion, I was asked to tell you in about five minutes what I consider to be the bases of a standard: a topic that I have spent several years attempting to clarify in my own mind. For example, twenty years ago I prepared a paper for internal distribution within our Inspection Engineering Department in which I touched upon the role of *specification*, *custom*, *precedent*, *authority*, and *natural law* in this connection.

When you can measure something and express it in numbers you know something about it that may make it possible to control it statistically. You can do something about it. When, however, you cannot measure something quantitatively or express it in numbers, your knowledge is of a less satisfactory kind. Now in the Bell System we endeavor to give a product that is satisfactory, adequate, dependable, and economic to the consumer. These variables are far more difficult, if not impossible, to measure. It is this picture that I want to say a word about.

What is a standard? I shall assume that a standard is set up as a model or example based on specification, custom, precedent, authority, or natural law. Any question of compliance with a standard is subject to review by the court as last authority in cases of dispute. Hence it is necessary for lawyers, as well as engineers, to have an understanding of statistical theory.

For each quality specified in a written specification, tolerance limits L_1 and L_2 are usually specified. In addition to these, for the simple case, statistical theory may call for two additional limits A and B and an expected value C for each characteristic. In the simplest case, statistical theory may then tell how to draw a sample in order to be interpreted or how to estimate the degree of control in terms of a properly chosen sample, or both. In short, we say drawn at random, from control, or both.

A standard may be a subject of legal contract between a purchaser and a supplier and subject to a decision about the acceptance of product. The statistician can, in general, arrange the product so that it can be sampled pretty much at random or he may know enough about the product to allow him to sample for control or he may use both methods. Here it is desirable that all necessary branches of statistics be used by the purchaser in writing his specification in order to give the best known method of attaining inspection plans that will insure high quality at least cost.

When we consider the life history of material going to the ultimate consumer, our job is a much longer and harder one but one of great new possibilities. Here one of the great difficulties is trying to find out consumer reaction now and how this is likely to change in the future. The first type of standard has to do with the acceptance of material and the second type concerns the performance of product over its life.

One important question is: How stable is the present preference for a particular thing? If the characteristics of the telephone users of tomorrow were to be essentially the same as those of the telephone users of today, and if the physical and social conditions tomorrow were to be essentially the same as today in the strict statistical sense, we could easily determine with considerable confidence the limits of fluctuation that might be expected in user preference. Naturally, however, this is not the situation. Before we can hope to be able to predict with great assurance the trend in user preferences even in this simple example, a lot of additional fundamental information is needed. For example, we would like to know: (a) how to measure the intensity of a given user preference, (b) how a given user preference for a particular kind of telephone service or instrument is related to his other preferences and wants, (c) how a user's preference depends upon physiological, psychological, and experience factors, (d) how a user's preference depends upon the preference of others, and (e) what are the particular physical factors or qualities of a telephone service or instrument that shape a given individual's preference—factors of which he is conscious and those of which he is not conscious.

To get an answer to such questions it is obvious that we must not only measure the preferences of a sample of users at some time but that we must study the variation in preference from time to time in this sample of users. Only very infrequently can we hope to attain our fundamental information about user preferences by a single spot check. Instead we must appeal to some type of controlled experiment where variations in preferences under different controllable conditions can be studied.

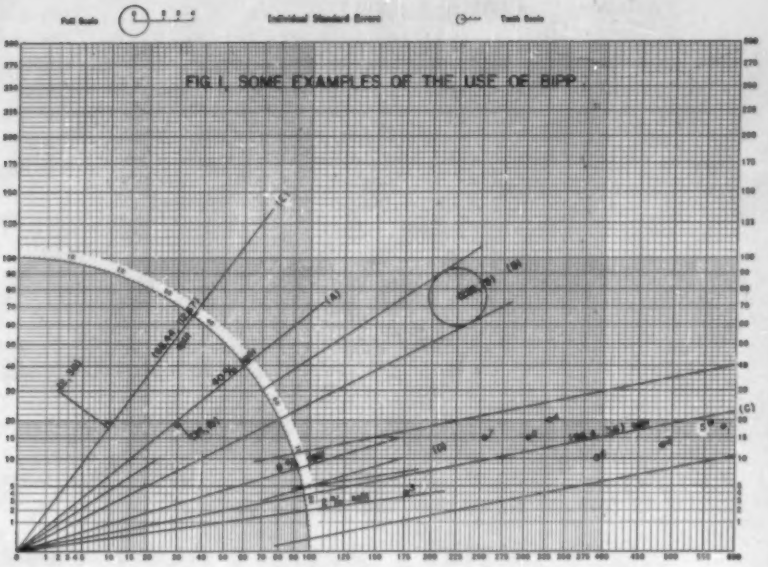
When now we consider the promise of management for SADE-Q, that is, satisfactory, adequate, dependable, and economic quality, we really appreciate the size of the job.

Twenty years ago one could see statistics as playing an important part in everything that an engineer does from the setting up of a standard to the life history considered as a consumer product, and that the full advantage of statistics would come only after leaders in almost every branch of learning were trained therein.

Have You Tried BIPP?

CHARLES R. HICKS

Purdue University, West Lafayette, Ind.



BIPP is not a more dignified form of BURP nor does it represent some government agency. The letters BIPP stand for **Bi**nomial **P**robability **P**aper, an invention of Mosteller and Tukey[1] available from Codex Book Co. This is a special kind of graph paper which has many useful applications in quality control. It is carefully described with many examples in Mosteller and Tukey's articles[1], but it seems worthwhile to present a few applications in *Industrial Quality Control* since these provide nice short-cuts to many practical problems with which we have to deal.

The paper (see Fig. 1) has two non-uniform scales: a horizontal scale from 0 to 600 and a vertical scale from 0 to 300. In working all problems, two things are plotted on the paper: the "split" and the "paired count." The split is a straight line thru the origin (0) and some point on the paper. This point usually represents the population (or theoretical) fraction defective p′. For a 10 percent defective lot one might locate the point (90, 10) [or (180, 20), (45, 5) etc.] and join it to the origin (0). This is called the ten percent line or the (90, 10) split. A "paired count" is simply the point representing the coordinates (number good, number defective). For 60 bad pieces in a sample of 250, one plots the paired count (190, 60) on the paper. At the upper left of the paper is a scale which is used to measure the perpendicular distance from the paired count to the split line. This measurement is in standard deviation units and 5 mm is approximately one standard deviation. To see how BIPP works on many diversified problems, we cite five examples.

A. To determine whether an observed number of defective items in a sample is significantly different from an assumed process average. Here we assume, as always when using the binomial, that the observations are independent and the process average, p′, remains constant.

Example: A lot has been averaging 40 percent defectives. If I choose a random sample of 50 parts and find 15 defectives, is this sufficient evidence that the lot sampled is better than average?

Solution: [See (A) on Fig. (1)]

(1) Plot the 40 percent split as a line from the origin through the point (60, 40).

(2) Plot the paired count (35, 15).

(3) Measure the perpendicular distance from the paired count to the line.

(4) Compare this measurement to the Full Scale units at the upper left of the paper which gives the distance in standard deviation units.

(5) As this distance is less than two (about 1.25σ), we usually conclude that our observed fraction defective is not significantly different from the 40 percent process average. In using two as our critical point we assume a five percent risk of being wrong in claiming that a lot is better or worse than average when it really *isn't*.

B. To determine confidence limits for a population fraction defective: p′.

Example: If I observe 75 defectives in a sample of 300, what are the 95 percent confidence limits on p′?

Editorial Note

Binomial Probability Paper has been in use as a statistical tool since at least 1949. However, we believe the papers by Hicks and Satterthwaite in this issue give applications of this useful technique which should be especially helpful in SQC operations.

There are undoubtedly other adaptations of this tool which some of our readers may have discovered for themselves and which are not generally known. IQC would be pleased to put before its readers any of these which appear unique and helpful.

Mason E. Wescott
Chairman, Editorial Board

Solution: [See (B) on Fig. (1)]

(1) Plot the observed paired count (225, 75).

(2) Construct a circle of radius 2σ (for approximate 95 percent confidence) around this point. A penny is just right for tracing this circle with an automatic pencil—not too pointed a lead.

(3) Draw two lines from the origin tangent to this circle.

(4) Where these lines intersect the "quarter circle" (marked on the paper in degrees) read off the coordinates: (80, 20) and (70, 30) which means the 95 percent confidence limits are from 20-30 percent.

C. To construct a p chart with varying lot sizes.

Example: Data on a process—

Lot No.	Lot Size	No. Bad.	No. Good
1	600	18	582
2	500	13	487
3	180	4	176
4	350	20	330
5	580	19	561
6	400	10	390
7	270	15	255
8	320	15	305
	3200	114	3086

Solution: [See (C) on Fig. (1)]

(1) Find $\bar{p} = \frac{114}{3200} = 0.036$ and plot the split (96.4, 3.6).

(2) Draw two parallel lines 3σ (measure on Full Scale—approximately 15 mm) above and below this average line. (Lay off the 3σ length at right angles to the average line.)

(3) Plot observed sample points as paired counts: (582, 18), (487, 13) etc.

(4) Points falling outside of the parallel lines indicate an out-of-control condition, as on the usual p chart. Here all eight points are in control.

Note: If order of points is to be maintained for examining runs, etc. one may plot a standardized p chart using the measured distances from the split and plotting these above and below 0 on a separate graph.

D. To design your own Single Sampling Plan.

Example: Set up a plan to give an AQL of two percent and an LTPD of eight percent with risk $\alpha = 0.05$ (producer's risk) and $\beta = 0.10$ (consumer's risk).

Solution: [See (D) on Fig. (1)]

(1) Plot the two percent and eight percent splits (say through (0) and (98, 2) and through (0) and (92, 8).

(2) You must accept 1.64 σ (for 95 percent, $[1-\alpha]$ from a normal curve table) above the two percent line and reject 1.28 σ (for 90 percent, $(1-\beta)$ from table) below the eight percent line. Hence draw two lines—one parallel to the two percent split and 1.64 σ (approx. 8.2 mm) above it and the other parallel to the eight percent line and 1.28 σ (approx. 6.4 mm) below it.

(3) Where these two lines intersect read the coordinates (100, 5).

(4) Sampling Plan is then

$$n = 100 + 5 - 1 = 104.$$
$$c = 5 - 1 = 4.$$

Note: n is one less than the sum of the coordinates, and
c is one less than the second coordinate.

E. To compare two variances—substitute F test in analysis of variance.

Example: From Griffith, Westman, and Lloyd's last example[4] on meat-canning, the following Analysis of Variance table is given:

	Sum of Squares	Degrees of Freedom	Mean Square	F	$F_{0.05}$
Batches	62.44	4	15.61	8.30	2.52
Cylinders	55.78	5	11.16	5.94	2.37
Batch and Cyl. Int.	48.48	20	2.42	1.29	1.75
Error	112.67	60	1.88		
Total	279.39	89			

To test for the significance of the batches effect on the weight of meat canned one uses the F test as shown above. Using BIPP:

Solution: [See (E) on Fig. (1)]

(1) Plot the batch Sum of Squares and Error Sum of Squares as a split—here the (62.44, 112.67) split.

(2) Plot ½ the respective associated degrees of freedom as a paired count: (½ × 4, ½ × 60) or (2, 30).

(3) Measure the distance from paired count (2, 30) to the line and compare with the Full Scale. Here this distance is about 4.5 σ. If this distance is greater than two on this scale we claim that the batch to batch differences are significant or have a significant affect on the weight. Here again we take the usual five percent significance level. The other F tests in the problem could be checked in a similar way using BIPP.

In some examples further refinements in the technique may be necessary and should be mentioned. A more complete discussion is found in Mosteller and Tukey's article[1].

1. The paired count, say $(n-d, d)$ where d is the observed number of defectives in a sample n, should really be plotted as a triangle with coordinates $(n-d, d)$, $(n-d+1, d)$ and $(n-d, d+1)$. Then the 'dis-

tance' to the split is usually taken as the perpendicular distance from the midpoint of the hypotenuse of the triangle to the split. As this triangle is hardly distinguishable from a point when d and (n − d) are large, the triangle can be ignored in many applications.

2. When the paired count exceeds the limits of the paper; i.e. greater than (600, 300) and less than (6000, 3000), the paired count may be divided by ten and plotted. In this case one uses the 'Tenth Scale' at the upper right of the paper to measure distances in standard units.

There are many more useful applications of BIPP which may be found in the Mosteller-Tukey article. Only a few which seem timely for the SQC man have been presented here in the hope that he may investigate further this useful graphic technique.

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2) Duncan, A. J., *Quality Control and Industrial Statistics*, Richard D. Irwin, Inc. (Chicago) p. 327-29, 351-52, 382

3) Dixon, W. J. and Massey, F. J., *Introduction to Statistical Analysis*, McGraw-Hill (New York) p. 196-199

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Source of Supply

Codex Book Co., Inc., Norwood, Mass., No. 31298 thin, No. 32298 heavy, Binomial Probability, Designed by Mosteller and Tukey.

Comparison of Two Fractions Defective

F. E. SATTERTHWAITE

Rath & Strong, Inc., Boston, Mass.

In many quality control problems it is desirable to compare two fractions defective (or other attribute fractions). Specifically, suppose that a process change has been made and sampling inspections show the following:

	Sample 1 Before Change	Sample 2 After Change
Number of Defectives	$d_1 = 10$	$d_2 = 25$
Number Inspected	$n_1 = 100$	$n_2 = 200$
Apparent Fractions Defective	10 percent	12.5 percent

Is the apparent increase in defectives from 10 percent to 12.5 percent a real increase, or is it a chance variation due to the relatively small numbers of pieces checked?

This question can be answered very simply with "binomial probability" graph paper (Codex Book Co., Norwood, Mass., Number 32.298) as shown in Fig. 1. The steps and interpretation are as follows:

(a) Plot the point, $n_1 = 100$, $n_2 = 200$, and connect it with the origin. (Line marked "true".)

(b) Plot the point, $d_1 = 10$, $d_2 = 25$. (Point marked "observed".)

(c) Compare the distance from (b) to the "true" line with the "sigma" scale at the top of the chart. (In this example the distance is about 0.5 sigma.)

(d) Convert this "sigma" value to the significance level:

Sigma Value	Significance Level	Confidence Level (In percent)
1.28	20%	80.0
1.64	10%	90.0
1.96	5%	95.0
2.57	1%	99.0
3.30	0.1%	99.9

Since the present example shows a sigma value of substantially less than 1.28 sigma, we conclude that these data are insufficient to prove that there is a real difference in fraction defective before and after the change in the operation; that is, the observed difference between ten percent and 12.5 percent may well be a chance fluctuation due to the small samples, $n_1 = 100$ and $n_2 = 200$, of parts inspected.

While these data do not prove that a difference exists, neither do they prove that the fraction defective remained unchanged. In many investigations it is desirable to know how large a change in true fraction defective is compatible with the data. This question is also readily answered with binomial probability paper as shown in Fig. 2. The detailed steps are as follows:

(a) Plot the point, $d_1 = 10$, $d_2 = 25$.

(b) Mark off a radius from this point equal to the desired number of "sigma". (In the present example we will determine "95 percent confidence limits". Therefore we want the "5 percent significance level", which is about 2 sigma.)

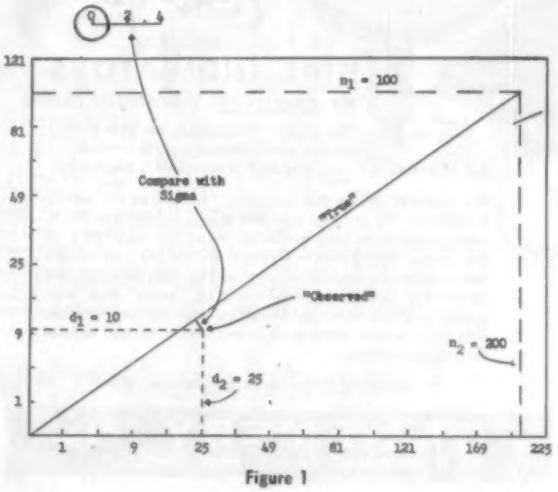

Figure 1

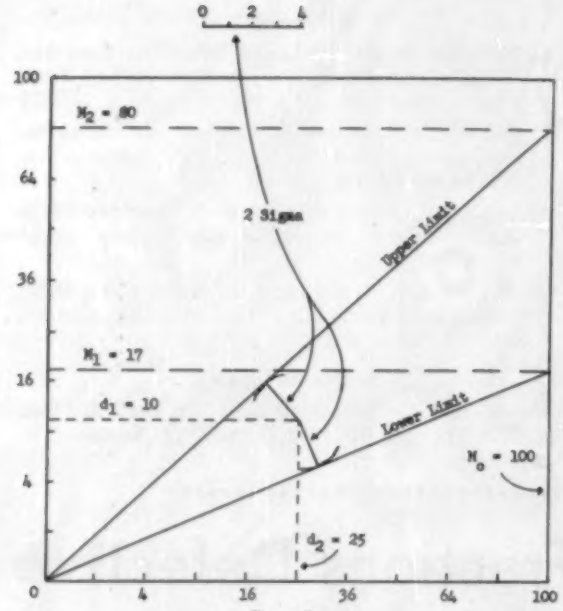

Figure 2

(d) Draw in "Upper Limit" and "Lower Limit" lines tangent to this radius and extend these lines to the vertical $M_0 = 100$ line. (M_0 is arbitrary and 100 is generally the most convenient value.)

(d) Read off the upper and lower values of M_1 and M_2

$$M_1 = 17 \qquad M_2 = 80$$

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(e) Calculate:

$$K = \left(\frac{n_1}{n_2}\right) M_0 = \left(\frac{100}{200}\right) 100 = 50$$

(f) The desired 95 percent confidence limits for the ratio, p_1 to p_2, are then equal to

$$\frac{M_1}{K} < \frac{p_1}{p_2} < \frac{M_2}{K}$$

$$\frac{17}{50} < \frac{p_1}{p_2} < \frac{80}{50}$$

$$0.34 < \frac{p_1}{p_2} < 1.60$$

One therefore concludes with 95 percent confidence that the fraction defective, p_1, before the change may have been as small as 34 percent of the fraction defective, p_2, after the change or it may have been as much as 60 percent larger. If it is desired to narrow down the effect of the change with greater precision than this, more data must be collected.

Mathematical Notes

This method is based on the fact that d_1 and d_2 jointly have a binomial distribution (approximately). It is not necessary to use binomial probability paper for the analysis. Any appropriate method can be used to determine if the "observed" fraction,

$$f = \frac{d_1}{d_1 + d_2} = \frac{10}{35} = 0.286$$

differs significantly from the "true"

$$f' = \frac{n_1}{n_1 + n_2} = \frac{100}{100 + 200} = 0.333$$

Also any appropriate method can be used to determine confidence limits, f'_1 and f'_2 for the "true" f' about the "observed" $f = 0.286$. The confidence limits on p_1/p_2 are then equal to

$$L_1 < \frac{p_1}{p_2} < L_2$$

where

$$L_1 = \frac{n_2}{n_1} \frac{f'_1}{1 - f'_1} \qquad L_2 = \frac{n_2}{n_1} \frac{f'_2}{1 - f'_2}$$

The *approximation* involved in assuming that d_1 and d_2 jointly have a binomial distribution is an assumption that d_1 and d_2 individually have Poisson Distributions. This will be true if d_1 and d_2 are small with respect to the sample sizes, n_1 and n_2. For practical purposes this will be true if the observed fractions defective,

$$d_1/n_1, d_2/n_2$$

are less than about 0.20 or 0.30.

The mathematical key to this method of analysis stems from the relation

$$\frac{d_1}{n_1} = k \frac{d_2}{n_2}$$

where k is the observed ratio of p_2 to p_1. This relation is readily rewritten in the form

$$\frac{d_1}{d_2} = k \frac{n_1}{n_2}$$

Since the sample sizes, n_1 and n_2, are fixed, we are now comparing the observed ratio, d_1 to d_2, with a fixed known ratio, n_1 to n_2, to estimate the value of $k = p_2/p_1$.

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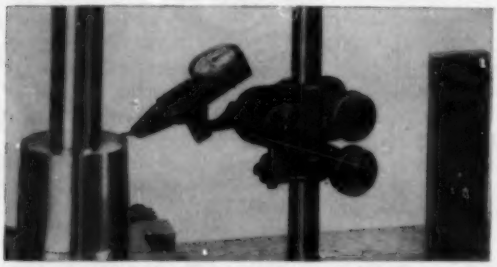

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Contact Pressure (gr.)	15-15	23-33	23-33	23-23	45-49	28-38
Contact Pressure Equal in Both Directions	YES	No	No	YES	No	No
On-Center Mounting Vertical & Horizontal	YES	No	Vert. Only	No	Vert. Only	No
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Local Section News

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ALBUQUERQUE The regular meeting was held Sept. 10 at Mitchell Hall, University of New Mexico. Initiating the new educational program of reviews of significant papers delivered at the 1956 convention, Everett Ard led a discussion of "A new method for evaluating cause" by A. L. Raich, Colorado Fuel and Iron Corp.

Don D. Edgar was guest speaker at the general meeting. His subject was "Vendor quality ratings." Mr. Edgar is a quality control engineer assigned to the vendor quality control rating system, Convair Div., General Dynamics Corp., Fort Worth, Texas. General interest in this subject developed a lively discussion.

On Tuesday evening, Sept. 25, J. Y. McClure, National Treasurer of ASQC, met with officers of the section and their guests for dinner. Mr. McClure discussed membership and program planning. Much to the gratification of the local officers, he reported that the Albuquerque section was third in membership growth among all 92 sections as of Aug. 24.

The section has established a $100 scholarship with the University of New Mexico in the name of the American Society for Quality Control. Recipients will be selected by the prizes and awards committee of the University from junior and senior students in the college of engineering who have satisfactorily completed or who have registered for the course entitled mathematical statistics. The scholarship is established to stimulate undergrad interest in statistical quality control and to provide an incentive for accomplishment in the field.

ALLENTOWN -BETHLEHEM A dinner meeting held Sept. 12 at the Ubangi Room, Walp's Restaurant, inaugurated the fall series of meetings. Paul A. Robert of the Gruen Watch Co. addressed the meeting; his subject, "What ASQC can do for the quality control engineer." Included in the scope of his talk were various possibilities for changes in membership requirements and the relationship of ASQC with other technical societies. Views of section members on various aspects of the talk were aired in the discussion period which followed.

The first meeting of the section sponsored course "Introduction to quality control" was held Sept. 24 at Muhlenberg College. Classes will be held for a period of eight weeks under the supervision of Miss Bonnie Small, who will be aided by instructors Dave Roberts, Dick Wetherhold, and Dick Zwickl. Fifteen members have enrolled in this class, which will be followed with course two, "Practice of quality control," starting Jan. 7.

BINGHAMTON The first meeting for the 1956-57 season was held on Sept. 11. The speaker for this session was Leon Gilford, chief of the quality control operations branch in the statistical research division of the U. S. Department of Commerce, Bureau of the Census. Mr. Gilford's topic was "Statistical methods in management."

The section is again sponsoring a course in statistical quality control at the North Hill High School in Binghamton in conjunction with the adult education department. The course will run for 12 weeks and the instructors are Charles H. Rubin, vice chairman of the section, and John Schneider, chairman of the education committee.

BOSTON The first meeting of the new season on Sept. 12 was enthusiastically attended. Dinner reservations were oversubscribed and many more came for the meeting. Warren Purcell spoke on the use of simple experimental designs in developing new facts. A considerable number of new members and guests were present.

BUFFALO The section, in conjunction with the University of Buffalo, is offering for the first semester a course on quality control entitled "Statistical quality control." The instructor is Sigmund Zobel who is also chairman of the section's arrangements committee.

The first fall dinner meeting was held on Sept. 25 at Cutts Hotel. The speaker of the evening was William B. Howells, Jr. of Bell Aircraft Corp. who spoke on "Incoming inspection and testing of component parts for electronic devices."

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BUZZARDS BAY Dr. A. C. Rosander, chief of the sampling and estimating section, Internal Revenue Service, U. S. Treasury Dept. in Washington, D. C., was main speaker at the Sept. 11 meeting held in the Conference Room of the Continental Screw Co., New Bedford. He discussed "Probability statistics applied to the control of tax return operations." A dinner for Dr. Rosander at the New Bedford Hotel preceded the meeting.

CHICAGO Three speakers appeared on a panel program at the Fox-Valley subgroup on Sept. 18 to present management viewpoints on the subject "What I expect from quality control." They were: E. Wagner, Bell And Howell Co.; E. G. Jurs, Elgin National Watch Co.; and Dr. M. D. Kilbridge, Illinois Institute of Technology

"Management Night" was the opening meeting of Chicago's regular series at the Furniture Club on Sept. 26. D. W. Gierke of the Controls Company of America spoke on the subject "Acquainting management with quality control techniques and problems" during the pre-dinner session. After dinner, Warren Jones, first president of the section, delivered an address entitled "Management needs quality control." His talk constitutes another outstanding contribution to the section's progress.

A group of more than 30 men were treated to a down-to-earth presentation of challenging ideas by Doug Allan, metallurgical statistical analyst for the American Iron and Steel Institute, at the Calumet subsection. The talk began with a discussion of the use of frequency distributions in setting national standards for the steel industry; weight allowances, dimensional tolerances, and chemical ranges. Then the speaker went on to point out practical considerations and advantages which result when skewed frequency distributions of a specific class are handled as portions of two separate normal distributions. Realistic 3-sigma limits can thus be set. Mr. Allan concluded his talk with sketches and discussions outlining the principles of G. E. P. Box's technique for determining optimum conditions in a process.

CINCINNATI Sept. 19 proved to be an excellent date to open the 1956-57 meeting as a large number of members and guests attended. The evening opened with a fine dinner followed by an enjoyable coffee talk by Edward Mason of the Cincinnati office of the F. B. I. Past President Paul A. Robert spoke on "Quality control—a new tool of management." As the principal speaker of the evening, Mr. Robert found a very attentive audience. The activities of the first meeting were concluded with refreshments and lots of hospitality provided by an energetic committee. The new format for the meetings—dinner, coffee talk, principal speaker, and refreshments—was such a success that section chairman Dave Birch emphasized that this same plan would be followed throughout the entire year.

The Hamilton-Middletown subsection opened the year's activities by having Frank Caplan speak on "Process control in a job shop" on Sept. 12. A fine crowd appeared at the Whirlpool-Seeger Plant and encouraged the subsection's officers to continue their splendid efforts to establish a full section in the Hamilton-Middletown area.

CLEVELAND On Sept. 6 the section held a combined plant tour dinner meeting at the Alcoa Heavy Forge Plant in Cleveland. Dr. Phillips Whidden of Alcoa's mathematical service section was the speaker.

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COLUMBUS The first meeting of 1956-57 season was held at North American Aviation with an attendance of over 60 percent of the membership. A very interesting and well versed meeting on "Receiving inspection" was conducted by M. L. Hoffman, assistant chief inspector of the N. A. A. Columbus Plant. After the meeting we were taken on a conducted tour of the receiving inspection department of N. A. A.

CORNING -ELMIRA The section started the season with a very successful meeting when over 100 members and guests turned out to hear Miss Bonnie Small, Dept. Chief of Engineering of Western Electric Co., Allentown, Pa., who discussed "Control chart analysis of engineering experiments." Miss Small showed how information obtained by present methods of analysis of variance can be obtained much more simply with control charts plus the effect of time in the experiments. The section is conducting an extensive membership drive in hopes of surpassing last year's membership which showed a 250 percent increase over the preceding year.

DALLAS -FORT WORTH The first meeting of the new year featuring Dr. Paul S. Olmstead drew close to a hundred quality control personnel and research and development guests. Dr. Olmstead brought the various analytical techniques in statistics into use as a rather commonplace statistical record was subjected to control chart and trend analysis. Significant features in the data with the underlying causes were displayed in the novel demonstration.

DANVILLE -SUNBURY The September meeting featured a kick-off dinner meeting to start the winter program. After the dinner meeting, a conducted plant tour of the Avco Corp., Div. of Lycoming Aviation Corp., was held to acquaint the members with the method of quality control used by Avco Corp.

DAYTON The section has organized a subsection at Lima, Ohio and to date has 18 new members. The speaker for their first meeting on Sept. 12 was C. E. Stines, chief inspector of the National Cash Register Co. and a member of the Dayton section.

The first regular meeting of the section was held on Sept. 19 at Delco Products Div., GMC. "Machine capability vs. product tolerance" was the title of the talk presented by Edward Oakley, Delco Products. His talk entailed a step by step procedure of things that need to to be considered when making machine capability studies. He also used an example to show how a simplified approach paid big dividends. Members of the Dayton section of the American Society for Tool Engineers were guests as well as many others from the local manufacturing companies.

The section was also honored by the presence of L. S. Eichelberger, Executive Secretary of the Society, at this first meeting.

DELAWARE The executive committee met on Sept. 20 at the home of vice chairman Hillman C. Harris to complete plans and preparations for activities throughout the 1956-57 season. Hillman, as chairman of the program committee, reported that the programs for the monthly meetings were nearly all firm and that the season's program offered a variety of subjects designed to make this series of meetings of particular interest and value to members and their guests.

ERIE The officers held several luncheon meetings prior to launching the 1956-57 program—last minute details, changes, confirmations, unconfirmations. Yea, the "physical" part of the geo-physical year. "New members signed up!" Some old members haven't paid their dues—"call em!"

Many members of the section acted as hosts at the various booths of the N. A. M.'s AMERICADE which is on a nation-wide tour. A few we might note in passing included Don Broderick, Dave Ferrell, and Clarence Haycox.

EVANSVILLE -OWENSBORO The first organizational meeting was held Sept. 25. Program scheduling for the entire year was accomplished; the scheduling being accomplished through "factory representatives" in several of the industries, each of which is responsible for one program during the year. In this way, the load of the program chairman, previously responsible for all programs, was relieved. In addition, our "factory representatives" are responsible for membership activity (increase in membership) within his own factory or industry.

We have established a membership drive on a contest basis. Since it has been agreed that all meetings this year will be dinner meetings, the prize for the membership drive will be that the section will pay for the dinner of that individual obtaining the greatest number of new members within the calendar month.

GEORGIA The Atlanta group of the section started the season of monthly meetings on Sept. 25. Robert D. Roche, manager of systems evaluation projects, military operations research engineering division, Lockheed Aircraft Corp., Marietta, gave a talk on "Operations research—what it is and how it works." After explaining operations research, he presented some slides showing the results of detail problems and their combination into the solution of major problems in selecting aircraft for military and civilian purposes. The hurricane "Flossy" cut the attendance, but considerable discussion was given.

GREATER MUSKEGON The first meeting of the 1956-57 season was held on Sept. 13. After a family style dinner of chicken and ham at "Doo Drop Inn," the group of 28 members toured the S. D. Warren Co.'s central paper mill. Jack Trump capably outlined the plant's process before the plant tour. Ninety percent of the mill's production is high quality coated and uncoated printing paper for books and advertising brochures. Quality control in their plant is a must to maintain their high standards.

HARRISBURG The final monthly meeting of the executive committee was held at the home of our immediate past president, Dan Meckley, in York on Sept. 19. All plans and the speakers' schedule for the year were approved.

The program committee and the education committee have lined up especially good schedules for the year. The list of speakers includes some of the most able men in the quality control field.

The education committee will be sponsoring three courses in quality control this year with both the basic and advanced being presented in York while the basic course only will be given in Lancaster.

HUNTSVILLE At the last meeting of the group, Bill Harrel of Redstone Arsenal gave a description of "The mechanics and advantages of multiple level sampling on continuous processes." Illustrations of reduction in inspection cost on specific projects were discussed.

KANSAS CITY The section opened the 1956-57 season with a good attendance at the Sept. 12 meeting. The meeting at the Blue Hills Restaurant started with a pre-dinner clinic at 6 pm with Orris Stewart as moderator and John Theurer and Arnold Holtan presenting gaging techniques in the development of the subject "Standard measurements of linear characteristics." After dinner the meeting consisted of a welcoming of members and guests by chairman Mike Putthoff and a review of goals and programs for the year's activity.

LINCOLN The section met Sept. 14 at "Marchis's" in Omaha. Twenty one members and 27 guests representing six towns and 23 companies were present. Chairman A. W. Pendry opened the meeting with a greeting to all members and guests. Prof. N. H. Barnard spoke briefly of the purpose of the Society for the benefit of the guests. Robert Lasho of Continental Can Co. described "Quality control at Continental Can Co." and K. E. Schroeder spoke on "An amateurs concept of quality control" expressing the need for a standardization of definition of terms used in quality control.

An interesting film on quality control in the U. S. Air Force concluded the program.

LOS ANGELES On Sept. 11 the section held a joint meeting with the AIIE and discussed "Work sampling." Every aspect of the field was covered by Dr. E. P. Coleman, UCLA; Dr. R. M. Barne, UCLA; R. Edgecomb, Virtue Bros. Manufacturing Co.; J. R. Crawford, Lockheed Aircraft Co.; Carl Boswell of Carl Boswell Associates; and Bob Andrews, UCLA.

MEMPHIS The first meeting of the 1956-57 season was held in the Community Room of the Leader Savings & Loan Association on Sept. 25. Charles Latimer, director of research and development, Nickey Bros., Inc., Memphis, spoke on "Numerical aids for management decisions" and described several examples of the use of linear programming in manufacturing.

The Saddoris Award correspondent, Frank O. Howland, gave a brief summary of the rules and described the various ways in which points could be obtained. Clayborn R. Bosworth, Mallory Air Force Depot, Memphis, completed his application for membership.

METROPOLITAN The annual Rutgers all-day conference on quality control is the kickoff of the Metropolitan section's annual season. This year's conference, on Sept. 8, proved traditional in its tremendous success, with 475 registrants attending the seven panel discussions and 413 participating in the luncheon and luncheon address by T. Bristol, vice president of Bristol Meyers. (The loss of 62 individuals at the luncheon is still an unsolved mystery.)

The attendance at the conference showed that its prime purpose to acquaint newcomers with the various aspects of QC was accomplished with close to half attending a conference on QC for the first time. The membership committee intends to follow up the "newly interested" as closely as good judgment permits.

The 1956-57 program for the section presents an ambitious and varied series of meeting types. Bruce May, our chairman, is driving toward a banner year by all fields.

MEXICO CITY A short course on statistical quality control was held recently with a total enrollment of 25. The course consisted of 90 minute lecture periods held twice a week for a period of two months.

MICHIGAN The Eleventh Annual Michigan Forum presented by the section in cooperation with the University of Michigan last Sept. 8 was a very successful event with attendance numbering in excess of 400.

F. L. Riggin, Jr., executive vice president of Mueller Brass Co., was the luncheon speaker. His subject, "What management should know about quality control" was very appropriate. Mr. Riggin contrasted his company's investment in quality control with its savings that resulted from the use of QC. Strangers to QC were amazed; friends of QC were delighted.

MILWAUKEE Each year the section has a special dinner and program for the top management of the companies represented in the membership. This years management night speaker was Francis Bucksot of the International Harvester Co., Indianapolis. His talk on "Top management's acceptance of quality control" has set a high level for the year.

MINNESOTA An afternoon of golf followed by a delicious dinner, a brief address by Bob Cosgrove, Green Giant VP, and an interesting "time-delay" movie on plant growth highlighted the

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social meeting held at the LeSueur Country Club, LeSueur, Minn.

MUNCIE The new season was opened Sept. 21 with an address by Leon Bass of General Electric's Evandale Division. Over and above the honor of playing host to the senior vice president of the Society we were treated by the speaker to an impressive parade of basic statistical methods applied to expensive problems with money saving results. His address, "Make it right the first time," emphasized again that very often the most effective quality control program is the one based on simple, clean statistical methods.

NEW HAVEN Leonard A. Seder, quality control consultant of Malden, Mass., addressed the first meeing of the 1956-57 season held on Sept. 11 at the Savoy Restaurant in Hamden, Conn. Mr. Seder's topic was "The SPAN plan method of process capability analysis." His talk proved to be one of extreme interest to those members in attendance.

PITTSBURGH Over 60 members and guests of the section attended the first meeting of the 1956-57 year to hear Dr. Irving W. Burr of Purdue talk on "Tolerances and specifications." In his talk and the discussion which followed, Dr. Burr commented on many of the fallacies and misconceptions concerning tolerances and specifications.

PITTSFIELD Twenty five members of the section made the trek to Springfield, Mass., to attend various sessions of the Tenth New England QC Conference. Douglas Slingerland and Donald A. Gensheimer of Pittsfield General Electric, George E. Lyman of Peter J. Schweitzer, Inc., Lee, Mass., and Thomas J. Sargent of Crane & Co., Dalton, acted in the capacity of moderators at a number of the sessions.

A large turnout—24 members and 13 guests—was present at our Sept. 19 meeting to hear Leo Jacobson. Leo gave an excellent discourse on the number of ways acceptance sampling may be used as a "tool" for making decisions.

The section's nine week course in basic quality control started Sept. 18 with the initial lecture "Frequency distributions" given by our section chairman, George Lyman. The course registration is presently 18.

RHODE ISLAND The first meeting of the 1956-57 year was held on Sept. 20. John F. Hird, quality control engineer at Taco Heaters, Inc., spoke on "Trouble shooting for quality improvement." Mr. Hird, who is also the section's newly-elected chairman, presented many general and specific methods of spotting, determining and eliminating problems encountered in inspection and sampling procedures. A thorough discussion of multi-vari charts and binomial probability paper in conjunction with trouble shooting was presented by the speaker.

ROCHESTER On Sept. 18 the first meeting in the present series was addressed by Dr. Martin A. Brumbaugh who is well known to all of us. His topic, "Statistical quality control and operations research," aroused considerable interest and discussion.

On Sept. 25 the first meeting of the gaging and measurement subgroup was addressed by John A. Harrington of the DoALL Co. The subject, "Principles and techniques in precision measurement," together with a 30 minute sound film, made for an interesting and informative evening.

ST. LOUIS Dr. Lewis Fowler, Monsanto Chemical Co., gave an interesting talk to the section Sept. 21 on "Precision and accuracy in measurements."

The section's one-day conference was very successful with fine representation from various St. Louis and out-of-town industries. The day started wth a short keynote address by C. Berger Graves, Sefton Fibre Can Co., on "Quality sells." ASQC President Dale Lobsinger, United Airlines, gave a most interesting version of "Quality control and the people it influences" which everyone present thoroughly enjoyed. At luncheon the participants of the conference heard David Nicholson of Nicholson-Kohn & Associates, Inc., Clayton, Mo., talk on "Man in the automated factory." The afternoon was spent working in one of three workshops: sampling inspection variables given by Robert L. Storer, Phillips Petroleum Co., Waco, Texas; frequency distribution analysis by Ervin F. Taylor, Westinghouse Atomic Fuel Div., Cheswick, Pa.; and process prediction by Joseph Movshin, Ramsey Corp. Everyone went home well fortified with some new ideas he might put to work.

The St. Louis section has changed its monthly meeting place from the Couteau House to the Arts Lounge, DuBourg Hall, St. Louis University.

SAN DIEGO The Sept. 10 meeting was held at the North Park Club preceded by dinner. The speaker of the evening was M. C. Copold, supervisor of manufacturing research and development at Convair, San Diego Div., General Dynamics Corp. The topic was "Automation" and the speaker assured all that machines would never replace men.

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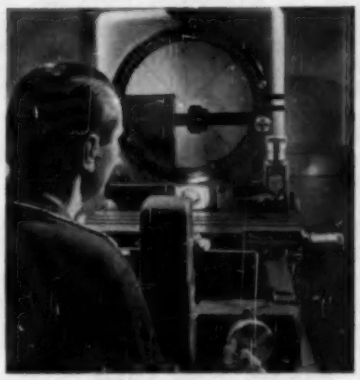

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SCRANTON -WILKES-BARRE The Sept. meeting was held as a dinner meeting at the "Deitrick," on Sept. 17. The speaker was Miss Bonnie Small, Dept. Chief of Engineering for Western Electric Co., Allentown, Pa.

Miss Small gave a very interesting talk on "Management training" with emphasis on who must be trained and the type of training required. Her talk was based on a six point quality control training program.

After the talk a question and answer period was held which was of great interest to all present.

SEATTLE L. E. Landon, president of Nalley's Inc. of Tacoma, was the featured speaker at the September meeting at the Benjamin Franklin Hotel. Mr. Landon discussed the relationship between sales and quality control. The emphasis on quality control in recent advertising was brought out in his interesting and timely talk.

SOUTH TEXAS Dr. Paul S. Olmstead presented a paper entitled "Statistical quality control in engineering research and development" at the September meeting. A dinner for members and guests preceded Dr. Olmstead's paper. Approximately 60 people were in attendance.

The 12 week basic course in quality control, being sponsored by the section, has been very well received with 108 registered. Classes began Sept. 27.

TOLEDO The September meeting of the section included a talk by Joe Scalzo on "Control in the water works program." Mr. Scalzo, in addition to being an excellent chemical engineer working with the city of Toledo on water problems, is perhaps better known as being the 1956 Olympic wrestling coach for the United States.

TORONTO Over 70 members and guests were on hand at the first meeting of the season held at the University of Toronto on Sept. 12 to hear George W. McDermott, supervisor of statistics and analysis, Delco-Remy Div., GMC, Anderson, Ind., explain the quality control training methods which have been used with success in his company.

On Sept. 26 the section visited the British-American Oil Refinery at Clarkson, Ontario. In addition to an examination of the control equipment, members heard papers on the control of refinery processes by Mike O'Callahan and Alec Brown.

UNIVERSITY OF WESTERN ONTARIO The first meeting of the year was a dinner party at Port Stanly, which was well attended. An interesting talk and demonstration was given by John B. Pringle of the Bell Telephone Co. of Montreal. Mr. Pringle employed many effective demonstrations in his lecture on the fundamentals of quality control.

WACO Our regular Monday night meeting was changed to Friday night in order that the section might hear Dr. Paul S. Olmstead of Bell Telephone Laboratories. A dinner meeting was held on Sept. 14 at 6:30 pm. Dr. Olmstead spoke on "Statistical research and development."

WASHINGTON Dr. W. R. Pabst, chief statistician, Bureau of Ordnance, discussed "Basic elements of the vendor-vendee problem" at the Sept. 26 meeting held at the YWCA.

At this meeting, plans were discussed by Dr. A. C. Rosander of the educational committee for the presentation of an educational course in quality control to be sponsored by the section.

WESTERN MASSACHUSETTS On Sept. 18 at the Sheraton-Kimball Hotel in Springfield the section held its first technical meeting. The 48 in attendance were given some excellent examples how "Statistical games against nature" can be used to advantage in making decisions. Dr. Harlan D. Mills of General Electric delivered the talk. In addition, a complete write-up of the technical aspects was made available for everyone in attendance.

WINDSOR The guest speaker at the opening meeting held at Mario's Restaurant on Sept. 19 was Howard Paillefer, District traffic and sales manager for Trans-Canada Airlines. He astonished and delighted those present with his description of how T.C.A. is improving the quality methods of its service to the public through the use of SQC methods with regards to rating employees for job placement and promotion.

WORCESTER On Sept. 20 Charles Carter from Rath & Strong Consultants gave a very interesting talk on "Pre-control" to a group of approximately 50. The meeting was highlighted by Mr. Carter with a stimulating discussion after his talk was completed.

"... CAST THEIR SHADOWS BEFORE"

ALBUQUERQUE John M. Wiesen, program chairman, announces that David A. Hill, quality control director of Hughes Aircraft Corp., will address the November general meeting on "Time-samples measure equipment performance."

ALLENTOWN -BETHLEHEM The regular monthly meeting for December will be held at Reading, Pa. on the evening of the 12th. A conducted tour of the Parish Pressed Steel Co. will be preceded by a short meeting and talk starting at 7 pm.

BINGHAMTON John W. W. Sullivan, metallurgical engineer with the American Iron & Steel Institute will address the group on Dec. 4. He will speak on "Applicability and inapplicability of MIL-STD-105A."

BOSTON Nov. 20 is the date of our next regular meeting. This is a change from the original schedule. This is a joint meeting with the Boston chapter of I. R. E. It will be of especial interest to those in the electronics and reliability fields. M. A. Acheson will discuss "Maximum rating systems." Plans are afoot for reviving the Merrimac Valley subsection. Details will be announced soon.

BUZZARDS BAY Charles A. Reed of the General Electric Co. in Ashland, Mass. will discuss "Visual inspection procedures" at the Dec. 11 meeting to be held at the Continental Screw Co. in New Bedford.

CHICAGO On Nov. 20 the Calumet subsection meeting, to be held at Al Knapp's Restaurant, Whiting, Ind., will feature E. W. Ellis' presentation of a talk describing applications of statistical

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methods to the evaluation of laboratory distillation tests at the Cities Service Oil Co.'s East Chicago refinery. The nature of these tests, design of the experiments, and calculations performed, will be presented in detail by Mr. Ellis who serves as resident chemist of the above refinery. The meeting will start at 6:30 pm.

At the start of this season's basic education program, to be held at 7:30 pm Nov. 27, Room 785, Roosevelt University, 430 So. Michigan Ave., the section will present John Louer. Mr. Louer will explain the importance of fundamental distribution patterns to the theory and practice of statistical quality control. He is supervisor, quality control, for Mills Plastic Div., Continental Can Co.

Topic of the second general meeting of the section will be ""Organization and operations of quality control programs." Two speakers from the Chicago area will discuss the process industry and manufacturing industry aspects of this subject during the afternoon session starting at 4 pm. At 7:15 pm, after time out for a social hour and dinner, there will be an illustrated talk on this subject by H. R. Harrison of Collins Radio, Cedar Rapids, Iowa. Mr. Harrison is president of the Iowa section. His presentation will deal with a program which was started in 1950. The organization of this program, methods used, savings achieved, and reports prepared for management, will be described. Meetings and dinner will be held at the Furniture Club. The date is Nov. 28.

On Dec. 11, at 7:30 pm, Chicago's introductory education program will feature Dale Gierke's presentation of "Control chart procedures," a complete introduction to control charts for variables. Mr. Gierke is quality control engineer for Soreng Div., Controls Company of America. The meeting will be held at Roosevelt University, 430 So. Michigan Ave.

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CINCINNATI On Nov. 28 John Hromi, statistician, U. S. Steel Co., Pittsburgh, will be the featured speaker at the regular monthly meeting. The topic will be "The design of experiments." The great emphasis being placed on research by almost all companies makes Mr. Hromi's talk a "must" for all who want to be informed on the prominent roll statistics may play in holding down the cost of research.

A joint meeting with the Cincinnati section of the American Chemical Society will bring to our group one of the leading figures in America in the field of organoleptic perception. On Dec. 12 Dr. E. H. Scofield, director of quality research, Joseph E. Seagram & Sons, Inc., Louisville, will present a paper on "Sensory evaluation." Dr. Scofield's vast knowledge and keen wit will make this meeting one of the most outstanding of the series.

The Hamilton-Middletown subsection will have H. J. Jacobson, quality control manager, P. R. Mallory Co., Indianapolis, as the main speaker at the Dec. 12 meeting. Another timely topic, "Quality control in purchasing," will be discussed by Mr. Jacobson. The meeting will be at Pillsbury Mills, Inc., Hamilton. Mr. Jacobson is well known for his activities in SQC and an informative practical evening will be offered.

CORNING -ELMIRA The first meeting of the new year will be held on Jan. 8 at the Baron Steuben Hotel, Corning. The speaker for this meeting will be J. Manuele, director, headquarters quality control, Westinghouse Electric Corp., Pittsburgh, who will discuss "Management accepts quality control."

DALLAS -FORT WORTH On Dec. 13 O. R. Weaver, chairman of one of the newer sections, Waco, will be speaker at Arlington State College on the subject "Using attributes for measurement of continuous variables in the rocket industry." Mr. Weaver is the manager of quality control in the rocket fuel division of Phillips Petroleum Co., McGregor, Texas. In his address Mr. Weaver will disclose the unique techniques of maintaining the exacting control necessary in the production of rocket propellants. Special recognition will be given to representatives of the bulk chemical manufacturers in the two-city area.

DAYTON The meeting for the month of December will be a social get-together at the Delco Lodge and will feature movies and entertainment. The meeting will be held Dec. 13.

DELAWARE The Dec. 6 meeting of the section will be held at the Lord DeLaWarr Hotel, Du Pont Parkway, Wilmington. Meredith E. Smith of the engineering service division of Du Pont's Engineering Department and a member of the section will be the principal speaker on the subject "New developments in replacement and failure analysis." This talk will enjoy wide interest throughout the membership, covering, as it does, the application of statistical methods to equipment maintenance problems and particularly preventive maintenance whereby optimum replacement schedules may be determined and thus reduce to a practical minimum unscheduled shut-downs arising from unforeseen failure of equipment.

ERIE On Dec. 4 Charles F. Bicking of The Carborundum Co., Niagara Falls, will present "Design of experiments." Dick Albitz, our section vice chairman, is setting up this meeting.

GEORGIA The regular meeting on Tuesday, Nov. 27, in Room 1833, Hurt Building at 7:45 pm, will present a special application in the textile industry. Jim N. Little, of Anderson, Clayton & Co., Atlanta, will talk on "Breaking strength of cotton with reference to Micronaire and Pressley." This will be an interesting study of correlation and the effective use of data to supply facts to management.

The usual short course in quality control is being planned at Georgia Tech. It is hoped that one evening course will also be given.

HARRISBURG The Dec. 5 meeting will be something of a "first." It will be the first attempt in the four year history of the section at presenting a "Ladies Night" program. We are fortunate in having for our speakers, Dr. and Mrs. Ellis Ott. While Dr. Ott is presenting his talk "Concept of a specification," Mrs. Ott will be entertaining the ladies with slides and a talk on the people and customs of India, from which country the Ott's have just recently returned.

KANSAS CITY The section will have their Christmas social meeting on the night of Saturday, Dec. 8. Members and friends will be accompanied by their ladies at this event which will be held at the Homestead Country Club.

LOS ANGELES Jack Mannion, staff assistant to the vice president and general manager of Northrop Aircraft Co., will discuss a method of evaluating quality and assuring conformance of incoming quality by the use of automatic data processing equipment at the Dec. 13 meeting of the Los Angeles section.

MICHIGAN Highlighting December activities for the section will be a presentation by Blair E. Olmstead of Prudential Insurance Company of America. Mr. Olmstead, a research analyst, will discuss "Clerical quality control applications." The Detroit chapter of the National Office Management Association will co-sponsor this Dec. 14 meeting in the Science Hall of Wayne State University in Detroit.

The Wolverine subsection promises an interesting evening at the Upjohn Co. of Kalamazoo. Harry L. Wehrly, quality control manager of Dow Chemical Co. will speak on "Planning and organizing for quality." This session is scheduled for Dec. 7.

MILWAUKEE Ladies' Night, Dec. 10, is the time when the members bring in the distaff side of their partnership. A dinner preceded by a cocktail party will be held at the Marquette University Union, 620 N. 14th St. A fine program of entertainment is scheduled to make the evening a gala affair.

MINNESOTA "Statistics applied to industrial engineering" will be Professor Charles R. Hicks' subject when he addresses the section Dec. 11.

NEW HAVEN On Dec. 11 a panel discussion, "Problems in quality control," will be held at the Winchester Club House, New Haven, Conn.

PITTSBURGH For the third meeting of the year, the section will have Enoch Ferrell of the Bell Telephone Laboratories, Inc., who will talk on "Control charts for the log-normal distribution."

ROCHESTER The technical subgroup of the section will meet on Dec. 4. The group will be addressed by Dr. Grant Wernimont, technical staff assistant, Color Print and Processing, Kodak Park Works, Eastman Kodak Co. Dr. Wernimont will talk about "The basis for interpreting results from a testing process."

On Dec. 18 the section will have as speaker, L. Kent Reitz, development engineer, Paper Service Div., Kodak Park Works, Eastman Kodak Co. Mr. Reitz will discuss "Fundamental applications of quality control in the chemical industries."

SCRANTON -WILKES-BARRE The members are looking forward to our December meeting which will be held Monday, Dec. 17. The speaker will be Clifford Anderson of Penn State University. Professor Anderson is teacher of industrial engineering and quality control and will talk on the "Theory of probability."

SEATTLE Bradley Jones of the law firm of Howe, Davis, Riese & Jones, will discuss the legal aspects of quality control at the December meeting to be held at the Piedmont Hotel on Dec. 11 at 6:30 pm.

SOUTH TEXAS J. L. Coburn of Convair in Fort Worth will speak on "Where is the payoff in a QC program" at the Dec. 12 meeting. It will be a dinner meeting and the place will be announced locally at a later date.

TOLEDO The November meeting will feature one of our own members in a talk on "Some statistical applications in the fabrication of glass." T. R. Meyer is director of quality control for the Kimble Glass Co., a subsidiary of Owens-Illinois Glass Co.

UNIVERSITY OF WESTERN ONTARIO On Dec. 12 there will be a plant tour of the London General Motors Diesel, Ltd. Following the tour there will be a special meeting held in the evening for foremen, supervisors, and technicians to discuss quality control and problems.

WASHINGTON On Nov. 28 Ralph Taylor of the Friez Instrument Div., Bendix Aviation Corp., Baltimore, will speak on "Buyer specification and quality control requirements from the viewpoint of the producer of complex equipment."

WINDSOR The Dec. 19 meeting will take the form of a Christmas party for the members and their families. Individual detailed notices will be forthcoming at a later date.

"AS YE SOW . . ."

COLUMBUS An all-day conference will be held in the Deshler-Hilton Hotel on Saturday, Dec. 1. We will have several outstanding speakers including Dale Lobsinger, Wayne Biklen, Dr. Juran and

James Coburn. As an added feature George W. McDermott will conduct a course in basic training. Robert Coffman, Timken Roller Bearing, is general chairman of the conference.

CORNING -ELMIRA The section is sponsoring a one-day seminar to be held Jan. 12, 1957 at the Corning Glass Center, Corning, N. Y. Case studies will be presented by members from Cornell University, Corning Glass Works, and other local industries.

DELAWARE An educational course in practical applications of statistical methods will be conducted under the leadership of Art Hawkinson, chairman of the education committee. This course will consist of five sessions of one hour each to be held in the hour immediately preceding the regular monthly dinner meetings. Members of the section will serve as lecturers on subjects on which they are recognized experts.

MEXICO CITY The section's revised edition of an SQC handbook, *Un Curso Abreviado De Control De Calidad*, has just come off the presses. Copies are available through the section secretary.

SCRANTON -WILKES-BARRE The local section is again cooperating with Penn State University Extension for a two hour evening class on statistical quality control. The course will again be taught by one of our section members from Dr. Eugene L. Grant's book, *Statistical Quality Control*.

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WESTERN MASSACHUSETTS On Thursday, Nov. 29, the section will hold its third all-day workshop. Len Seder, quality control consultant, will conduct the workshop on "Process capability analysis." It will be held at Western New England College, YMCA Bldg. Registration fee is $7.50 and may be made by contacting Carl O. Baumann, Monsanto Chemical Co., Springfield, Mass.

WORCESTER The section is planning an all-day education series for this fall. The date has not been set as yet. This day long program will be conducted by men from local industry and will deal with the day to day operation of quality control.

UNIV. OF CALIFORNIA A course in engineering and management to be held on the Los Angeles Campus of the University of California Jan. 21-31 has been announced.

A daily instruction period for each of 25 different subjects for the full ten days will be included in the 8 am to 5 pm lectures. The program is designed to be of value to all levels of engineering and management personnel.

Subjects to be covered include; general management principles, engineering and research administration, managerial adjustment to labor law and union relations, leadership principles, the economics of plant investment and equipment replacement, a laboratory in leadership, as well as specialized work in motion study and simplifications of work, work measurements, and allied topics.

Information concerning course material and housing during the conference period as well as registration details, is available on request to Edward P. Coleman, Engineering Extension, Room 3104, University of California, Los Angeles 24, Calif.

NATIONAL SYMPOSIUM RELIABILITY AND QC IN ELECTRONICS The third national symposium on reliability and quality control in electronics will be held on Jan. 14-16, 1957, at the Hotel Statler in Washington.

With the increasing emphasis in both military and commercial areas on reliablity, it behooves the QC engineer to abandon or modify his earlier concepts of satisfactory quality levels in the order of 1/10 to two percent and reorient their thinking along lines of 0.001 percent and definitions of failure rates in terms of X numbers of mean hours before failure. To stay abreast of this rapidly expanding field, the IRE, ASQC, RETMA, and AIEE have searched their ranks for those men most prominent in each of their respective fields and have arranged to have them prepare papers on their field of specialization.

J. M. Bridges, Office of the Assistant Secretary of Defense, will present the keynote address on "A review of the progress that has been made in reliability in the past year."

The following timely topics will be discussed; "Mathematical considerations of reliability," "Management and manufacturing considerations of reliability," "Component reliability," "Systems reliability," and "Reliability and its effects on quality control." The latter topic is sponsored by the electronics division of ASQC.

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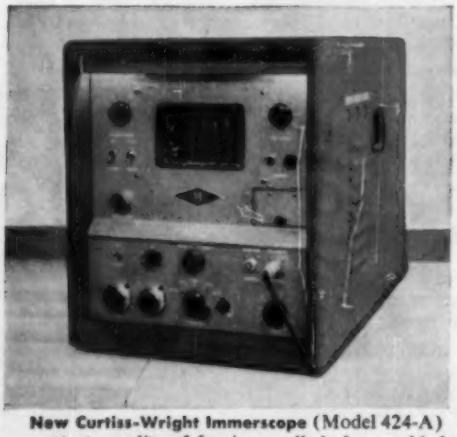

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In addition to these subjects there will be four panel discussions on such topics as: "Trends in airborne reliability;" "System reliability analysis;" "Quality acceptance practices and procedures as affected by reliability considerations;" "Basic definitions used in reliability."

Information concerning registration for the symposium may be had by contacting R. G. Murrell, Registration Chairman, Melpar, Inc., Falls Church, Virginia.

INTERNATIONAL CONFERENCE ON OPERATIONAL RESEARCH An international conference on operational research is being organized by the following societies: Operations Research Society of America; The Institute of Management Sciences, U. S. A.; and the Operational Research Society of Great Britain. The conference will be held at Oxford, England from Sept. 2 to Sept. 6, 1957. The object of the conference will be to unify and extend the science of operational research and papers will be presented in four sessions comprising the wholeness or underlying unity of operational research, the methodology, and the applications.

Further information regarding this conference will be circulated later this year. In the meantime, proposed papers are invited and summaries totalling not more than 200 words should be sent to Dr. Thornton Page, 7100 Connecticut Avenue, Chevy Chase, Md.

Opportunities will be made available for people coming from abroad to visit British operational research establishments studying specific problems or using specific techniques. Arrangements are being made to publish the conference proceedings.

"FOR MANY ARE CALLED, BUT FEW ARE . . ."

CLEVELAND The following officers have been elected for the 1956-57 season: chairman—Howard O. Schmidt, Aluminum Company of America; vice chairman—Paul W. Kuckuck, Weatherhead Co.; secretary—Charles H. Joseph, American Greetings Corp.; Treasurer—C. E. Wolf, Dobeckmun Co.

"I hate to make a nuisance of myself always but we've been running 98 percent rejects for two days now."

PITTSFIELD New officers for 1956-57 for the section are as follows: chairman—George E. Lyman, Peter J. Schweitzer Inc.; vice chairman—Thomas J. Sargent, Crane & Co.; secretary—Douglas Slingerland, G. E. Co.; Treasurer—Lawrence Spooner, G. E. Co. (We are sorry to lose our secretary elect, Fred Grayson, who has left the area for an advanced position in New York City.)

RHODE ISLAND The resignation of William P. Hammerly as chairman of the section was received and accepted. John F. Hird, Taco Heaters, Inc. was unanimously approved by the council as the new chairman. Designated and elected for the office of vice chairman was Cazemiro M. Antonio, U. S. Rubber Co.

WINDSOR Officers elected for the year 1956-57 are: chairman—George A. Dowling, Ford Motor Company of Canada, Ltd.; vice chairman—Ross E. Goulin, A. C. Wickman, Ltd.; secretary—Clarence E. Laforet, Bendix-Eclipse of Canada, Ltd.; treasurer—James McMillan, Ford Motor Company of Canada, Ltd.

DIVISIONS

Administrative Applications Division

Two newsletters have been mailed to division members to date. The first brought several requests for additional information regarding member John Neter's new book. He has, in fact, co-authored two books just published this year, which should be of interest to many members: *Fundamental Statistics for Business and Economics* by Neter and Wasserman, published by Allyn and Bacon College Division, and *Statistical Sampling for Auditors and Accountants* by Vance and Neter, published by John Wiley and Sons.

Dr. Carl Noble, division program chairman, has been promoted to manager of market research for Kimberly Clark's Cellucotton Division in Chicago.

The division is sponsoring the December issue of *Industrial Quality Control*. Reviewing the papers were Bill Pabst, Charles Bicking, Carl Noble, and Howard Jones. Les Eichelberger was responsible for the advertising.

Plans for the division's technical conference at the Congress Hotel in Chicago on Feb. 8-9, 1957 are now complete and details will be announced soon.

MEMBERSHIP CORNER

In order to maintain a communications "grape-vine", many sections appoint a "key man" or "committee man" in each plant in the area. In addition to providing a fast contact to communicate changes or last minute plans, the right man will talk and promote section meetings and other activities so that by group action, he will create interest and attendance in meetings which may result in membership.

As an aid in maintaining membership renewal interest, think about the fundamental fact that everyone likes a bit of recognition. A new acknowledgment procedure has been adopted by the Society (details will be available shortly), which will provide a uniform acceptance

and acknowledgment procedure for new members and also provides for acknowledgment of members who are upgraded.

The use of the pocket card for registering members and non-members at meetings is quite universally used and here is a new wrinkle used by the Southern Connecticut section. Two colors are used, one to identify members and the other non-members. Each card has a tear section which is left at the door to provide an attendance tally and carries a brief description of the aims and objectives of the Society. It also invites the guest to obtain additional membership information.

The two colors permit easy identification of members and non-members. One specific reason for this arrangement is that executive committee and older members circulate at the meetings and make a particular point of introducing new members to others. The first several meetings are sometimes awkward for new members whose acquaintances may be limited. We believe this vastly adds to the possibility that they will continue their interest in the Society.

The use of a feature newspaper article can be of considerable general interest to the public and by its publication, have considerable influence on promotion of membership to prospective quality and inspection people. In addition, these articles are usually read by many industry people through all levels of management who acquire familiarity with the Society, its aims, its objectives and, the function it performs in local industry.

Such an article can stress the part that quality plays in building sales and can have considerable tie-in with community benefits obtained through wide acceptance of locally made high quality products. This is the key idea which will make such an article acceptable for publication. Other points such as a high level of employment can be related to steady incomes, purchasing power and full employment as a result of wide acceptance of locally manufactured products. The tie-in of prominent stores carrying nationally advertised brand names and those with a quality reputation can include products which are made locally.

One example is a release prepared by W. Gordon Thompson of the Cincinnati section which is non-technical and of broad general interest. One or two appropriate and related photographs will enhance such an article. More satisfactory results can be had by working with a feature writer of the newspaper after a draft has been made. In this way, suggestions can be obtained which will meet the newspaper requirements and at the same time, be of value to the section.

Publicity for the section programs and activity is the all important medium by which section information is circulated and interest created which means attendance and possible membership. To a great extent, meeting attendance and support of the general membership is directly reflected in the quality and quantity of publicity effort.

Aside from the circulation of meeting notices and general publicity to the members and potential member-guests, it is important to obtain reasonably good coverage of mid and top management level in industry. This can be done with mailing lists available to technical societies from local offices of the Manufacturer's Association, Chamber of Commerce, and Industrial Council. Some sections affiliate themselves with one of these local offices in their area and receive substantial benefits from guidance and advice in respect to the conduct of their activity. In this manner, management becomes

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exposed to and somewhat familiar with the name, the programs, the general activity of the Society. As expected, later support of individual participation by their personnel is more readily forthcoming.

Chamber of Commerce publications and various plant newspapers in your city are also excellent mediums by which to publicize section meetings and other activities to members and management alike. As a suggestion, the entire year's program can be published with a suggestion that it be clipped for wallet reference. If publication is frequent enough, subsequent individual meeting notices can be carried, mentioning that complete programs are available from members of the committee or by requesting them from the Society. Many sections have had much success with a wallet type program for convenience in carrying and maximum retainability.

An additional source of potential new members is to follow up the constantly occurring industry and personnel changes. These notices appear in engineering society papers, trade and technical magazines, and in a great many cases, local newspapers. They concern new industry moving into the area, new personnel being assigned to the area and, promotions and new responsibilities assigned to existing personnel in the area.

In the case of new industry, a telephone call will usually provide the name of a Chief Inspector or Quality Manager and from that point, other names can be obtained. A letter preferably written by the chairman or secretary should offer a welcome to the area and include an invitation to attend the section meetings and meet local people. In many cases, this provides an opportunity to meet other people who have common interests.

This first invitation should be on a personal basis and can be followed up by the membership committee after the contact has been made and interest created. Many sections have had the experience of contacting and obtaining members by this method who have proved tremendous assets to the section and to the Society.

Many sections take a few minutes at each meeting to announce names or, introduce new members who have been accepted since the last meeting. Mention of company affiliation is usually desirable.

It is possible to use newspaper items regarding acceptance of new members. These can be separate announcements or can be included in meeting news items. Names and company affiliation make very desirable newspaper copy.

SIGNIFICANT DIFFERENCES

The promotion of Binghamton section member Alex Kramich to the position of IBM salary and wage administrator for manufacturing, all plants, was recently announced by the company. Mr. Kramich will be located at the IBM headquarters in New York City.

Here are a few items of interest regarding the membership of the Boston section.

Frank Kilduff of General Electric (Telechron) has received a promotion and is being transferred to New Jersey. His place as membership chairman is being taken by Bud Tenney of Hood Rubber, a newcomer in section affairs.

Several papers have been given recently by section members from Raytheon. Herb Hoyle gave a paper on quality control of reliable tubes at the National Electronics Conference held in Chicago. He had previously given the same paper at the Wescon Reliability Confer-

ence in Los Angeles. Harold Davis, co-author, presented it at the Reliability Conference in Dayton in May. He also gave a talk on control of visual inspection (by the same authors) at the N. E. QC Conference. Bernie Goldsmith discussed the use of quasi-range at the same conference.

Carl Nickerson, visual aids chairman, has accepted an instructorship at Wentworth Institute.

Dr. Evan J. Lewis, senior member of the Corning-Elmira section and director of works control laboratory and founder of quality control at Corning Glass Works, has retired after 27 years service with that company. He received his degree in chemical engineering from the University of Pennsylvania, his M. S. in physics from Penn State, and his Ph. D. in physics from Cornell University. Dr. Lewis also was an instructor at both Penn State and Cornell prior to coming to Corning. He is a Ten-Timer, having attended all national conventions of ASQC. The Corning-Elmira section is proud indeed to have him as a charter member and joins with the Society in wishing best of luck and hopes that he will maintain his interest in quality control along with his hobbies of gardening and woodworking.

Edward J. Delate, member of the Buffalo section, has recently been transferred to Wilmington where he becomes head of the electronic computing section of the Film Department of DuPont. The Delaware section extends a hearty welcome and we know Mr. Delate will continue the same active participation in the affairs of the Society at Delaware as he did at Buffalo.

Fred Reinhold, vice chairman of the Dayton Section, has resigned his duties to accept a quality control position with the Ronson Cigarette Lighter Co. at Stroudsburg, Pa. Our loss is their gain; congratulations and best of luck, Fred.

J. F. Verigan, Fellow, Delaware section, has resigned his position with the Atlas Powder Co., and has accepted a post with the Crown Cork and Seal Co., Baltimore.

Dallas H. Parker, a member of the Kansas City section, has recently been promoted by Bendix Aviation, Kansas City, to chief mechanical inspector.

George I. Craycraft, senior member of the Milwaukee section, is now with the quality control group of the John Oster Mfg. Co., Milwaukee.

Minnesota section members B. W. Brown, Jr., and E. A. Johnson of the Biostatistics Division of the School of Public Health, University of Minnesota, presented a paper titled "An approach to sensitive vaccine screening procedures" to a meeting of the American Statistical Association. Mr. Brown more recently moved to a new position with the Louisiana State University.

R. E. Keane, past section officer of the Minnesota section and senior quality control engineer at Minneapolis-Honeywell, was promoted to inspection supervisor of Honeywell's research and development project at Monrovia, Calif.

Pittsburgh section senior member Paul R. Brucker has been named metallurgist in charge of all flat rolled products at the Midland Works, Crucible Steel Co.

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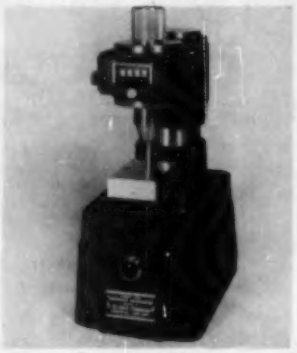

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Robert L. Storer, Chicago section member and author and co-author of several articles that appeared in *Industrial Quality Control*, has jointed Phillips Petroleum Co. as assistant manager, quality control branch, at Air Force Plant 66, near McGregor, Texas, according to E. A. Malick, Rocket Fuels Division Manager.

In the June issue of IQC it was erroneously reported that Dr. Marjorie L. Sutherland was leaving the Clopay Corp. when she moved to Indianapolis with her husband, Henry Jacobson. Mr. and Mrs. Jacobson did move to 4222 Broadway, Indianapolis, Ind., but Dr. Sutherland is remaining as director of quality control for the Clopay Corp., Cincinnati, Ohio.

William L. Lieberman, chairman of the Chicago section's popular "basic educational program," is now quality control director of Pentron Corp. Bill formerly was affiliated with The Gudeman Co. Both companies are in Chicago.

I. H. Pollack has been named quality control manager for the Ohmite Mfg. Co., Skokie, Ill. He is active in the Society as recording secretary of the Chicago section and is also active in the Institute of Radio Engineers as program chairman of the professional group on engineering management.

Eugene D. Goddess, chairman of the Seattle section, recently resigned from the Boeing Airplane Co. to organize a general management consulting service.

Paul Meier, statistical research analyst, spoke before the Methods Engineering Council at the Penn-Sheraton Hotel in Pittsburgh. Mr. Meier, who is a member of the Toledo section, spoke on the subject of "Linear programming on distribution and stabilizing production."

Bibliography

JOSEPH MOVSHIN, *Editor*

Assisted by the Editorial Committee, St. Louis Section, ASQC

9220 Old Bonhomme Road, St. Louis 24, Mo.

APPLICATION—
AUTOMOTIVE INDUSTRY

IMPROVED PISTON QUALITY THROUGH STATISTICAL CONTROL, by Ray J. Stanish, and George S. Holzheimer, (Thompson Products, Inc.)
(Automotive Industries, v. 114, n. 10, May 15, 1956, p. 69)

This article describes the installation of a Quality Control program in the production of automotive piston pins. A distribution of the diameter classes of pins is used as a measurement of control. The effectiveness of the program and some details of the approach are given.

APPLICATION—
CHEMICAL INDUSTRY

A CASE FOR QUALITY CONTROL, by L. M. Debing and E. C. Harrington, Jr., (Monsanto's Plastics Division)
(Industrial & Engineering Chemistry, v. 48, n. 5, May, 1956, p. 36A-39A)

This article outlines the applicable methods and advantages to the use of Quality Control in the acceptance of raw material and for in-process controls. Illustrations of control charts and some undesirable conditions in process variation with time are given.

APPLICATION—
ELECTRICAL INDUSTRY

A STATISTICAL METHOD FOR PREDICTING INSULATION LIFE, by W. H. Horton, (Westinghouse Electric Corp., East Pittsburgh, Pa.)
(Electrical Engineering, v. 75, n. 5, May, 1956, p. 442)

Regression analysis is used to predict insulation life in terms of the absolute temperature in accelerated tests. A regression line relating insulation life and absolute temperature is used as a baseline. A confidence envelope is used.

APPLICATION—
METALLURGICAL INDUSTRY

QUALITY CONTROL OF INVESTMENT CASTINGS (Part Two), by Charles Yaker, (Plant Mgr., Misco Precision Casting Company)
(Precision Metal Molding, Feb., 1956, p. 55)

This is the second article in a series discussing the development of tools and process techniques to produce the basic quality desired. Considered are pattern cavity, proper gating, the mold preheat temperature and metal-pouring temperature. Various suggestions are given with respect to specific details that should be checked in production samples. The first article of this series was reported in the June, 1956 Bibliography.

QUALITY CONTROL OF INVESTMENT CASTINGS (Part Three), by Charles Yaker, (Plant Mgr., Misco Precision Casting Company)
(Precision Metal Molding, Mar., 1956, p. 37)

This third article in the series describes process variables and their effect on investment casting quality. A table outlining various areas of variability, the variable itself and the effect on quality is given. These are discussed in more detail in the article itself.

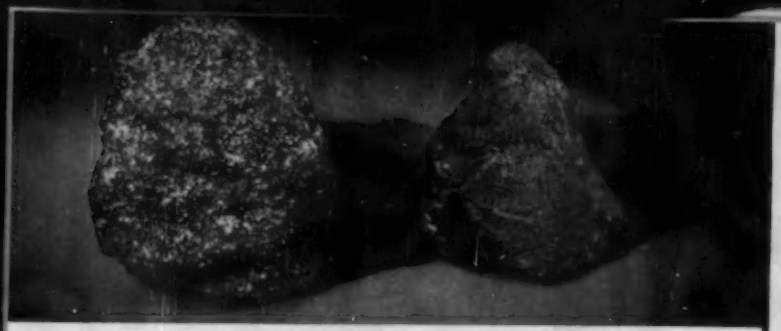
APPLICATION—
METAL WORKING

PARTS PRODUCED TO SIZE BY AUTOMATIC QUALITY CONTROL, by David N. Smith, (Jones & Lamson Machine Company)
(The Tool Engineer, v. 34, n. 8, Aug., 1955)

An automatic control for a lathe setup is accomplished by providing what amounts to an automatic built-in control chart. As tool wear and drift goes beyond a certain limitation of variation, machine readjusts for either oversize or undersize. Actually, the "statistical intelligence" of the unit also includes a simplified sampling procedure for zones at the end of the distribution and beyond.

Selected references in the Bibliography of *Industrial Quality Control* are obtained from the following sources:

The International Statistical Institute, *International Journal of Abstracts on Statistical Methods in Industry.*



Different In Every Way! New 44 ALUNDUM abrasive (at right) *looks different* from ordinary aluminum oxide abrasive, with a finer grained surface that denotes greater density and toughness. That's because it's *made differently*, by a special Norton-developed process. And that's why it *performs differently*, with new time-and-money-saving "Touch of Gold" advantages.

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W-1738

44 ALUNDUM abrasive gives excellent results on many grinding applications

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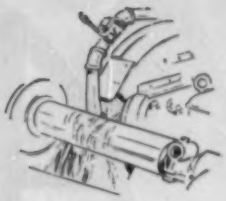
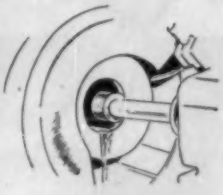
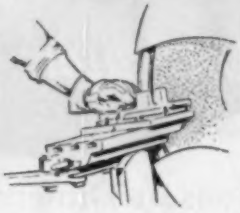


CYLINDRICAL



INTERNAL

SNAGGING



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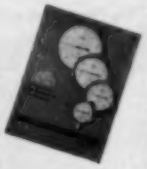

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APPLICATION— MISCELLANEOUS

THE USE OF STATISTICS IN RESERVOIR OPERATIONS, by Victor A. Koelzer, (Hydr. Eng. Bureau of Reclamation, U. S. Dept. of the Interior, Wash., D.C.) (Proceedings of the American Society of Civil Engineers, v. 82, n. HY3, June, 1956, paper 1008)

Statistical procedures are described which can be helpful in scheduling water reservoir operations. These methods can furnish an evaluation of the operational chance involved in such reservoir operations in terms of the water supply probabilities. Potentialities for variation in water supply and the probability of occurrences of extremes must be considered. As these extremes often dictate operational needs, proper evaluation of the probability of extremes is necessary. The yearly plan can be developed considering these factors.

ENGINEERING AND EXPERIMENTS

STATISTICAL DESIGN, by W. J. Youden
(Industrial & Engineering Chemistry, v. 48, n. 4, Apr., 1956, p. 107A-109A)

Some comments on curve fitting with illustrations of specific approaches are given in this article. The fitting of data to a straight line using an estimate of the standard deviation is presented. The advantages of shifting axis to reduce arithmetical calculations are given. An example illustrating the procedure is given. The "F" ratio can be used to measure the effectiveness of constants in fitting the observed data.

INDUSTRIAL MANAGEMENT

MAINTENANCE OF TIME STANDARDS, by Edward V. Krick (Dept. of Ind. & Engineering Adm., Cornell University) (Journal of Industrial Engineering, v. VII, n. 2, Mar.-Apr., 1956, p. 56-62)

The need for the maintenance of time standards is discussed along with problems resulting from failure to maintain such standards. The detection of standards that have become tight or loose is made through the use of histograms and a performance chart which is essentially a simplified control chart.

MISCELLANEOUS

UPDATING THE ACCURACY IN MEASUREMENT OF SCREW

THREADS, by Eric G. Gabbey, (O-Vee Gauge Company)
(Tooling and Production, v. XXII, n. 6, Sept., 1956, p. 91-95)

This article discusses and has illustrations of some of the errors that can occur in screw threads, pitch, angles, etc. Some of the limitations of various gaging methods are discussed. The advantages of the O-Vee method are discussed and illustrated.

STATISTICS

ON THE SIMULTANEOUS ANALYSIS of VARIANCE TEST, by K. V. Ramachandran
(The Annals of Mathematical Statistics, v. 27, n. 2, June, 1956, p. 521-528)

CHARTS OF THE POWER OF THE F-TEST, by Martin Fox
(The Annals of Mathematical Statistics, v. 27, n. 2, June, 1956, p. 484-496)

TABLES OF EXPECTED VALUES OF ORDER STATISTICS AND PRODUCTS OF ORDER STATISTICS FOR SAMPLES OF SIZE TWENTY AND LESS FROM THE NORMAL DISTRIBUTION, by D. Teichroew
(The Annals of Mathematical Statistics, v. 27, n. 2, June, 1956, p. 410-426)

THE LARGE-SAMPLE POWER OF RANK ORDER TESTS IN THE TWO-SAMPLE PROBLEM, by Meyer Dwass
(The Annals of Mathematical Statistics, v. 27, n. 2, June, 1956, p. 352-373)

THE THEORY OF DECISION PROCEDURES FOR DISTRIBUTIONS WITH MONOTONE LIKELIHOOD RATIO, by Samuel Karlin and Herman Rubin)
(The Annals of Mathematical Statistics, v. 27, n. 2, June, 1956, p. 272-298)

ALTERNATIVE MODELS FOR THE ANALYSIS OF VARIANCE, by Henry Scheffe
(The Annals of Mathematical Statistics, v. 27, n. 2, June, 1956, p. 251-269)

OPERATIONS RESEARCH

TACKLING OLD PROBLEMS WITH NEW TOOLS FROM OPERATIONS RESEARCH, by John M. Allderige, (Eastman Kodak Company)
(Advanced Management, v. XXI, n. 9, Sept., 1956, p. 9-12)

The author comments on the fact that some of the complexities of operations research and its applications have presented problems in the use of this technique. Actually, when applied to specific management problems, industrial engineers can use operations research very effectively. A specific technique and area of application is illustrated. Presented is controlling service labor by the Queueing theory. The details of calculations and approach are presented. The importance of measurement and the use of a model is stressed.

What's New?

ROY A. WYLIE, *Editor*

When inquiring about "What's New?" items, please mention INDUSTRIAL QUALITY CONTROL

The Blak-Ray Model B-100 multipurpose long wave ultra-violet radiation source for chromatography, laboratory research, inspection and medical observation has just been put on the market by the **Black Light Corporation of America**, San Gabriel, Calif. The light can be used in any method requiring a concentrated source of ultra-violet at 3660 angstrom units and is readily adaptable to any task. The lamp head is attached to the base through a spring-tension arm which allows the ultra-violet beam to be rotated in a 180 degree arc; a trigger mechanism makes it easy to slip the light source from base and maneuver it by hand with a pistol-grip handle, and for mounting over a lab table or inspection booth there is a D-ring on the back of the lamp head. Light source may be either a 100-watt flood or spot type long wave ultra-violet bulb. A 5 inch rounded, heat-resistant, red-purple filter specially selected to transmit ultra-violet rays blocks out the visible light. Provision for easy installation of an extra filter to reduce visible light further has been made. The spot bulb emits a beam which will fluoresce an area 15 feet in diameter from a distance of 30 feet. The flood bulb will activate an area 30 feet in diameter from a distance of 30 feet.

★ ★ ★

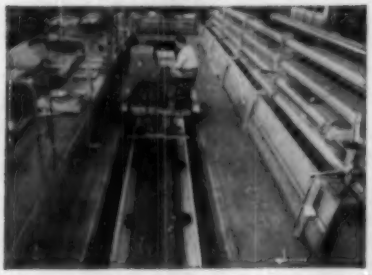
A new, low-cost laboratory-type test equipment calibrator with accuracy of 1 percent or better in all of its voltage sections is now offered by **B & K Manufacturing Co.**, 3731 N. Southport Ave., Chicago 13, Ill. The unit calibrates VOM, VTVM and other meters, signal generators, sweep and marker generators and oscilloscopes. It supplies 2, 5, 25, 100, and 300 volts D.C. and 5, 25, 100, and 300 volts A.C. to check voltage ranges. It provides 10, 100, 1,000, 10,000, 100,000 ohms and 10 megohms to check resistance ranges. It supplies a crystal oscillator capable of generating harmonic frequencies well over 300 mc, with accuracy of 1/10th of 1 percent. Plugging in the proper crystal makes possible the use of the unit as a marker generator in radio and television receivers, and to check the calibration on AM signal generators, or check and align the audio I.F. system of TV receivers. The crystal oscillator and pentode amplifier of the calibrator can be converted into an audio oscillator to signal-trace trouble in the audio amplifiers in AF, FM, and TV receivers, and high fidelity equipment. Size of the unit is 8¾ inches high, 8 inches wide, 5½ inches deep and net weight is 6¾ lbs. Price is $54.95.

★ ★ ★

The **J. W. Dice Co.**, Englewood, N. J. has announced the model HDR Carson-Dice Digital Read-out Electronic

Sperry
ultrasonic inspection news

40-Foot Aluminum Extrusions Inspected Under Water



How to inspect 40-foot, 1850-lb. aluminum extrusions for internal defects prior to machining into helicopter blades?—Piasecki Helicopter Corp., Morton, Pa., required an immediate answer to this problem.

The solution was provided by Sperry Products' Commercial Testing Service. At Sperry's Danbury laboratory personnel and equipment were available, including a 100-foot tank which would permit ultrasonic immersion inspection of the huge extrusions.

Actual inspection was done with a Sperry UW Reflectoscope and a PH Positioner. Mounted on an ele tric car which also carried the operator, this unit was capable of testing at speeds ranging from 2 feet to 32 feet per minute.

To best meet your individual inspection requirements, consult Sperry Products Commercial Testing Service. Return coupon for full information.

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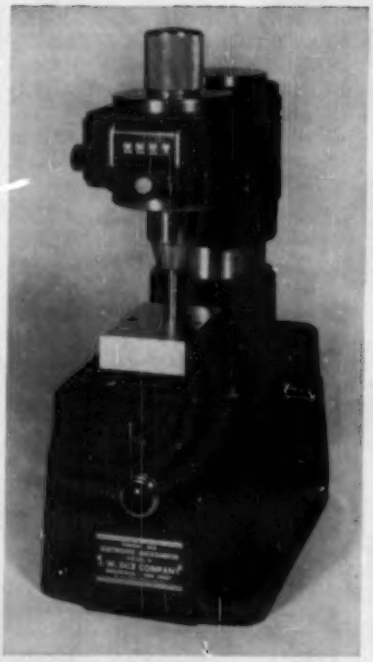

Micrometer. The digital read-out counter on the front of the instrument displays the exact reading in ten thousandths of an inch. Five divisions between each digit on the unit wheel permits reading to 20 millionths of an inch. Elimination of the human sense of touch in setting the instrument is effected by the electronic circuit which responds to instant of contact between the micrometer anvil and the work before any pressure is built up on the work by the micrometer screw. A motor drive automatically brings the micrometer precisely to the point of contact at a speed faster than can be done manually. The model HDR has a measuring range of 1 inch and a throat depth of 2 inches. The upper head is adjustable in height to accommodate work up to 2 inches and the standard anvil is readily removed for use of special fixtures. Repeatability is 0.00002 inches. The operating cycle is several times faster than the best speed possible with manual operation. Upon release of the actuating lever the micrometer spindle automatically backs off to permit removal of the work. If oversize work is presented to the instrument and touches the micrometer spindle, the control system automatically drives the micrometer up until the work is cleared. An optional foot switch which plugs into a socket on the rear of the base can be used instead of the lever switch to leave both hands entirely free for handling work. An operating knob at the top of the instrument permits rapid shifting of zero to any position within the 1 inch range in setting up the instrument. The unit is 11 inches high, 9 inches deep, 5½ inches wide. Power required is 18 watts at 115 volts A.C.

★ ★ ★

Invitation to Sheffield's Eli Whitney Metrology Lab

A cordial invitation is extended by the Sheffield Corporation, Dayton, Ohio to visit their Eli Whitney Metrology Laboratory. Visitors are given an opportunity to tour the laboratory and to view a gage block set up on an Absolute Interferometer capable of measuring to an accuracy within one millionth of an inch.

The above photo shows Mary Hoskins, metrologist in the laboratory, setting up the interferometer to measure the absolute length of a 2-inch master gage block to an accuracy of one-millionth of an inch—a fraction equivalent to one inch in 15.8 miles.

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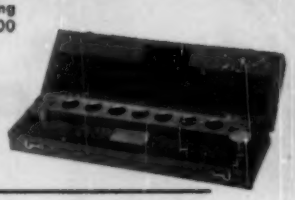

An improved method for detecting surface flaws by visual inspection on non-porous materials is now being marketed by **Zaco Laboratories**, a division of Zip Abrasive Co., 1360 W. 9th St., Cleveland 13, Ohio. This new two-step inspection process locates cracks, fractures, cold shuts, tiny surface fissures, porosity and imperfect welds on iron, steel, brass, aluminum, porcelain, plastics and ceramics. By spraying a thin coat of Dyeline Dye and following with Dyeline Detector, the exact location, type and extent of defects will appear sharply and clearly against an opaque background. In only 2 minutes dwelling time, the dye and detector will reveal cracks as small as 0.0002 inches in width. Smaller cracks can be detected by increasing the dwelling time. A water wash removes Dyeline immediately. The material comes in aerosol and bulk containers.

★ ★ ★

Development of a new timing-recording instrument, called the "Monitorecord" specifically designed for split-second monitoring of multi-operational automatic machinery, has been announced by the **Sheffield Corp.**, Dayton 1, Ohio. Fourteen or more operating sequences can be simultaneously timed to within one hundredth of a second and recorded on a strip chart for ready visual reference. The instrument is about the size of a portable radio and can be quickly connected to the electrical control circuit of any machine. The "Monitorecord" can be plugged into the electrical control circuit without shutting the machine down, and no other external power supply is required. The start, stop and duration times of the various sequences are timed and recorded on a five inch chart of pressure sensitive paper. A handy time scale of 0.2 seconds to the inch is marked on both sides of the chart, and there is ample space between lines for making notations. The "Monitorecord"

is useful in establishing proper relationship of automatic sequences and allows optimum timing for the most efficient machine, transfer, assembly, inspection and other operations characteristic of today's automatic equipment.

★ ★ ★

A low-price, pocket-size pH meter for acidity and alkalinity measurements that is accurate, dependable, easy-to-operate and uses a combination electrode is in production by the Scientific Instruments Division, **Beckman Instruments, Inc.,** 2500 Fullerton Rd., Fullerton, Calif. The new "Pocket pH Meter" is a battery-operated instrument having a wide variety of applications. It can be used in agricultural and soil research and testing, food processing, metal finishing and plating, chemical and industrial research and testing laboratories. It also has a wide use in school, college and university laboratories and in spot checking on pH equipment installed in a process plant. Range of the meter is from 2 to 12 pH. The single electrode combines both the reference and glass electrodes and has been especially developed for use with the new "Pocket pH Meter." The instrument also has a "memory" dial for use in standardizing. It operates from flashlight or hearing aid batteries.

★ ★ ★

A new electronic resistance thermometer covering a range from minus 100 degrees C. to plus 900 degrees C. with 0.01 sensitivity and digital reading of temperature dirently has recently been introduced by the **Manostat Corp.,** 20 North Moore St., New York 13, N. Y. Accuracy of the thermometer is 0.1 degrees C. up to 400 degrees C. and 0.2 degrees C. up to 900 degrees C. To maintain this accuracy each resistance bulb and bridge is individually calibrated. The vacuum sealed platinum elements and leads in the resistance bulb have a hermetically sealed head and offer a choice of stainless steel or quartz jacket. There is also available a plug-in

PRECISION PRODUCTION PROBLEMS?

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★ ★ ★

The Instrument Division of **American Optical Co.**, Box A, Buffalo 15, N. Y., has introduced a new line of stereoscopic microscopes under the trade name, Cycloptic Series. Greater comfort, greater ease of use and lower prices have been achieved by a new design incorporating the Magni-Changer, a calibrated cylinder containing 16 achromatically corrected optical elements. Desired magnifications are simply "dialed-in" by rotating the Magni-Changer. Resultant magnifications range from 3.5X to 80X. All Cycloptic models are supplied with inclined, reversible, binocular bodies, standard apochromatic objective; wide-field eyepieces and desired auxiliary lens attachments. The rack and pinion focusing adjustment has adjustable tension to suit individual preference. The working range is up to eight inches to allow examination of large specimens. A wide variety of models are available for both laboratory and general industrial use.

★ ★ ★

The King 8-Scale Instrument Test Manometer with 61 inch scale length is announced by **King Engineering Corp.**, Box 640, Ann Arbor, Mich. This Manometer is enclosed in a heavy-gauge steel case and is regularly furnished with a tripod base. Wall mounting brackets are also available. Scales are mounted on an 8-sided vertical drum, permitting any scale to be rotated into reading position beside the glass tube. Scale

1956 Shewhart Medal Nominations

Nominations are now being received by the Shewhart Medal Committee for consideration with respect to the 1956 Shewhart Medal Award. Previous Medalists are:

L. E. Simon	— 1948	E. L. Grant	— 1952
H. F. Dodge	— 1949	H. C. Romig	— 1953
M. A. Brumbaugh	— 1950	E. G. Olds	— 1954
G. D. Edwards	— 1951	W. E. Deming	— 1955

A letter of notification is being sent to all ASQC Section chairmen. Any member of the Society is privileged to make a nomination for this honor. It is important, however, that any nomination be accompanied by suitable biographical and other information supporting the nomination so that the Committee will be able to give adequate consideration to the qualifications of the nominee.

Nominations should preferably be forwarded to the Shewhart Medal Committee through the Chairman of the local Section, but may be sent direct with supporting information (10 copies, please) to the Chairman of the Medal Committee, H. F. Dodge, c/o Bell Telephone Labs., Inc., 463 West St., New York 14, N. Y. Nominations received by the Medal Committee on or before December 1, 1956, will receive due consideration.

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calibrations are in any desired units such as pounds per square inch, feet of altitude, or knots air speed. The scale drum can be adjusted vertically through a range of 3 inches to compensate for changes in barometric pressure. A four-page catalog giving details and specifications is available from the manufacturer.

★ ★ ★

A new Vibration Pickup Preamplifier manufactured by Bruel & Kjaer is now being marketed by the **Brush Electronics Co.**, 3405 Perkins Ave., Cleveland 14, Ohio. This instrument is designed as a link between Brush Accelerometers or any type of vibration pickup and one of the Brush AF Analyzers or Amplifiers. Users are thus provided with absolute measurement or recording of acceleration, velocity or displacement. The instrument performs three functions. A two-stage preamplifier with high input impedance allows vibration measurements to be carried out to very low frequencies at extended distances from the measuring instrument. A built-in calibration unit, consisting of a vibrating disc suspended on a metal strip which is brought into resonance at the line frequency, affords a direct and quick calibration of the combination of accelerometer, preamplifier and measuring instrument before the measurements are carried out. A set of integrating networks is provided for measurements of the velocity and displacement of the vibrations in consideration.

★ ★ ★

NEW LITERATURE

The Impact-O-Graph Corp., 1900 Euclid Ave., Cleveland 15, Ohio, has published a new brochure covering the various types of Impact-O-Graphs and their applications. These units are 3-directional mechanical impact, acceleration and gravity recorders. The fundamental purpose of the Impact-O-Graph is to record shocks, impacts and vibrations from any direction. Usual application is to check shock and vibration in the shipment of various products.

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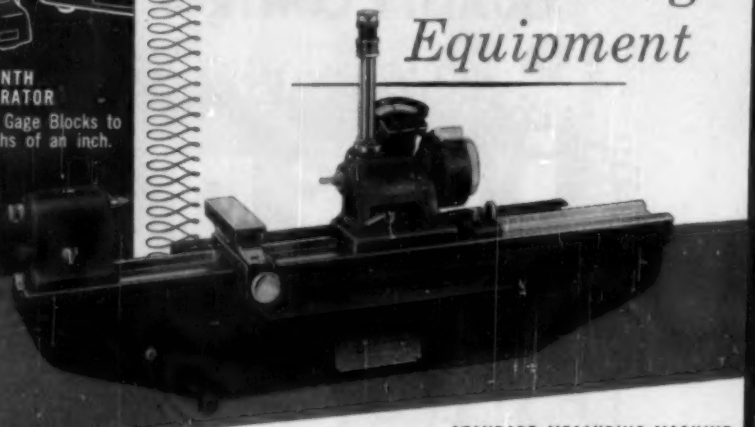

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Allied Radio Corp., 100 N. Western Ave., Chicago 80, Ill., announces the release of a new 64-page Electronics Data Handbook that consists of a collection of the most often needed formulas and data used in radio and industrial electronics. Formulas include those needed for basic circuit analysis, transmission line calculations, determination of vacuum tube characteristics, resonance calculations, meter calculations, etc. The book is available at 35 cents postpaid.

The DoALL Co., 254 North Laurel Ave., Des Plaines, Ill. announces an educational service to industry that teaches quality control men "How to be Their Own Bureau of Standards." Endorsed by the National Bureau of Standards, the program reveals the procedures to be employed by gage block users to inspect and calibrate with assured accuracy their own gage blocks with relatively inexpensive equipment. The program is offered in a free training course at the DoALL Technical Institute, Des Plaines, Ill. Length of the course is four days.

A new 6-page brochure describes the construction, operation and function of the seven current models of vibration fatigue test machines made by All American Tool & Manufacturing Co., 8027 Lawndale Ave., Skokie, Ill.

Custom Scientific Instruments, Inc., 541 DeVon Street, Kearny, N. J., has issued catalog CS-56. This catalog contains illustrations and brief descriptions of 37 instruments for testing textiles, plastics, paper, insulation, extensometers, dial indicators, light metals and other materials.

A 16-page brochure describing the new Beckman Model "111" data system is now available from Beckman Instruments, Inc., 2500 Fullerton Road, Fullerton, Calif.

POSITIONS AVAILABLE

Address all replies to box number references to: American Society for Quality Control, Room 6197 Plankinton Bldg., 161 W. Wisconsin Ave., Milwaukee, Wis.

Paper manufacturer with multi-plant operation has opening for engineering graduate in its staff Quality Control Department. This man should have statistical or quality control education or experience. A self-starter with initiative, and the ability to work with others. Headquarters in Berkshires (Western Massachusetts). Send resume and salary expected to Personnel Dept., Peter J. Schweitzer, Inc., Lee, Mass.

(Continued on page 48)

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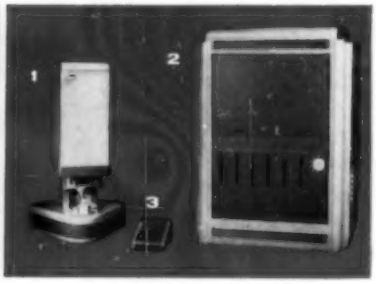

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